

## Chapter II. Resource Assessment

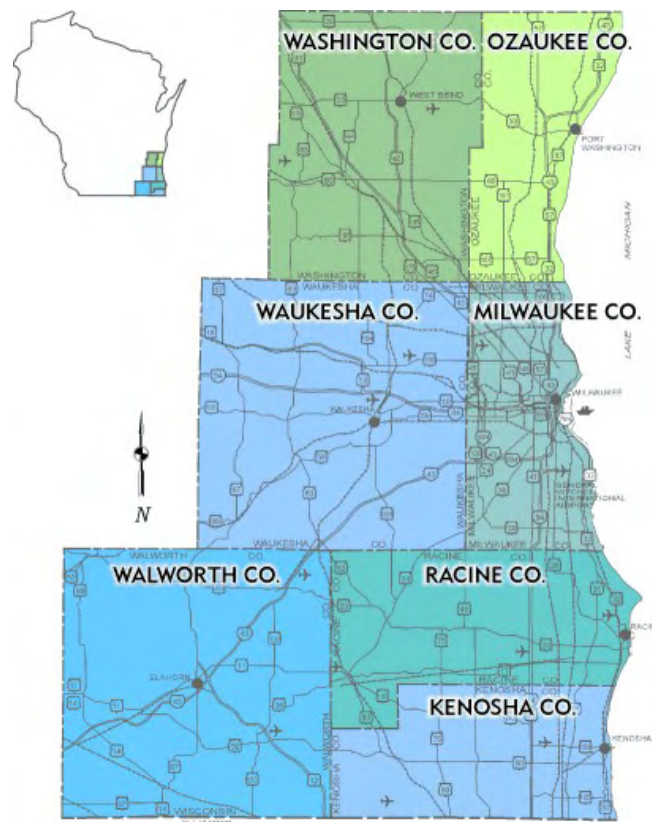
### Introduction

Waukesha County is a rapidly urbanizing county bordering the west side of Milwaukee in southeastern Wisconsin, as shown in Figure II-1 below. The county is made up of 16 survey townships, covering approximately 580 square miles or 371,600 acres. Located within its borders are 37 municipalities, including 7 cities, 18 villages and 12 towns, as shown in Map II-1.

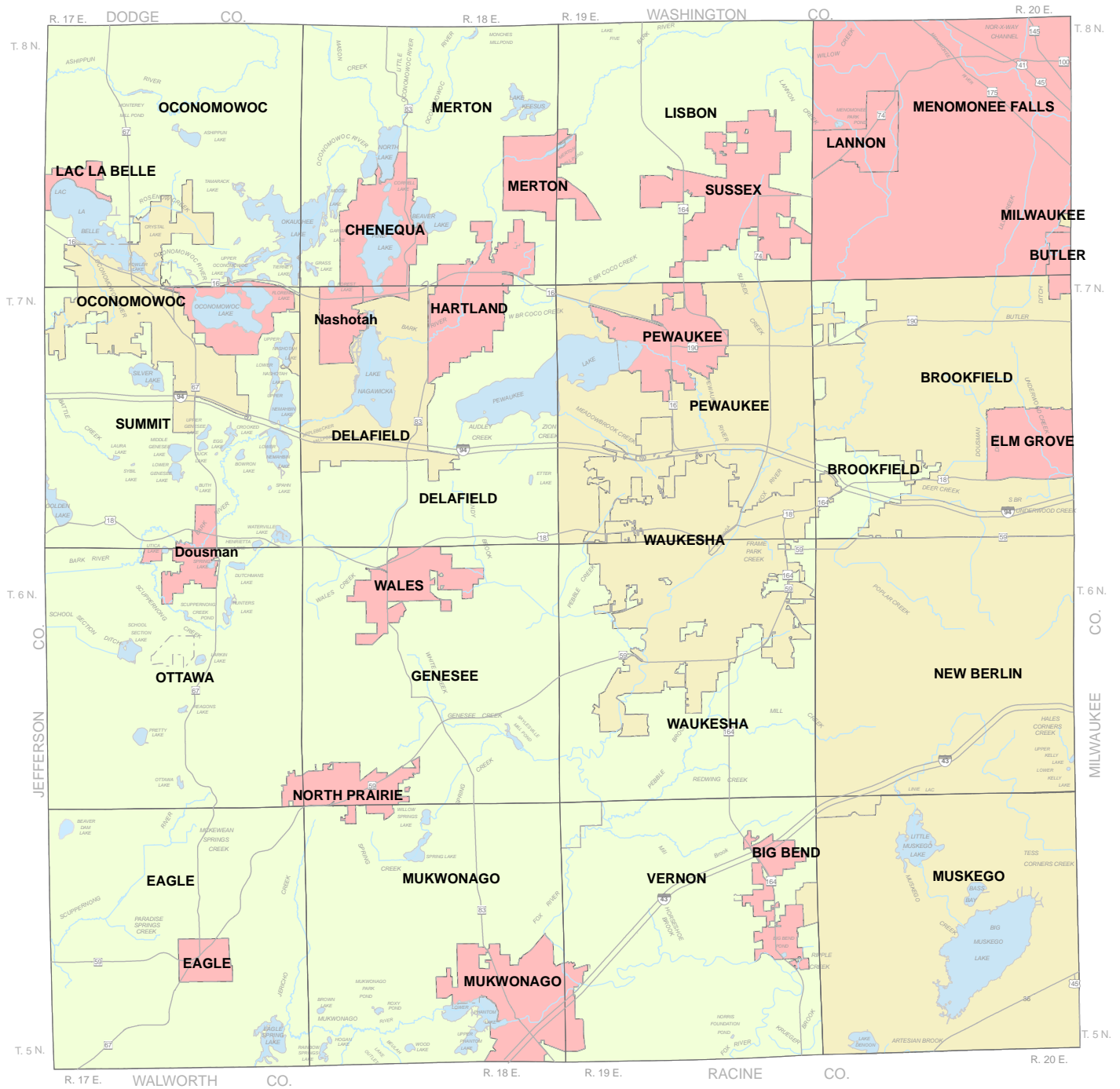
The natural resource base of Waukesha County is one of the most important factors influencing the quality of life and the economy for residents within the county and the region. Without sufficient understanding and recognition of the character and importance of the various elements of the natural resource base, human use and alteration of the natural environment proceeds at the risk of excessive costs in terms of both monetary expenditures and environmental degradation. A sound and meaningful planning effort must therefore acknowledge that natural resources are limited, and that land use decisions be properly adjusted to the natural resource base so that serious and costly environmental problems can be avoided.

This chapter presents descriptive information pertaining to the natural resource base of Waukesha County. This information was used by the LRD and the LWRM Plan Citizens Advisory Committees as a basis for identifying resource concerns and generating the goals and objectives presented in Chapter III.

**Figure II-1  
Location of Waukesha County**



## Map II-1 Waukesha County Municipalities



### Legend

- Towns
- Villages
- Cities



0 1 2  
Miles

0 4,000 8,000 12,000 16,000  
Feet

Source: Waukesha County



## Population

Current population estimates for the 37 municipalities and a cumulative total for the county are shown in Table II-1 below. Figure II-2 shows the population growth in Waukesha County between 1960 and 2000, as well as projections for 2035. Figure II-3 shows the number of households (see Appendix for definition) during this same time period. A projection of population and households is important for land use and public facility planning. Households directly influence the demand for urban land as well as the demand for transportation and other public facilities and services. Note that while the population of the county is projected to increase by 24% to 446,800 by 2035, the number of households is projected to increase by 29% to 174,100 due to the projected lower number of persons per household.

**Table II-1**  
**2005 Estimated Municipal Populations in Waukesha County**

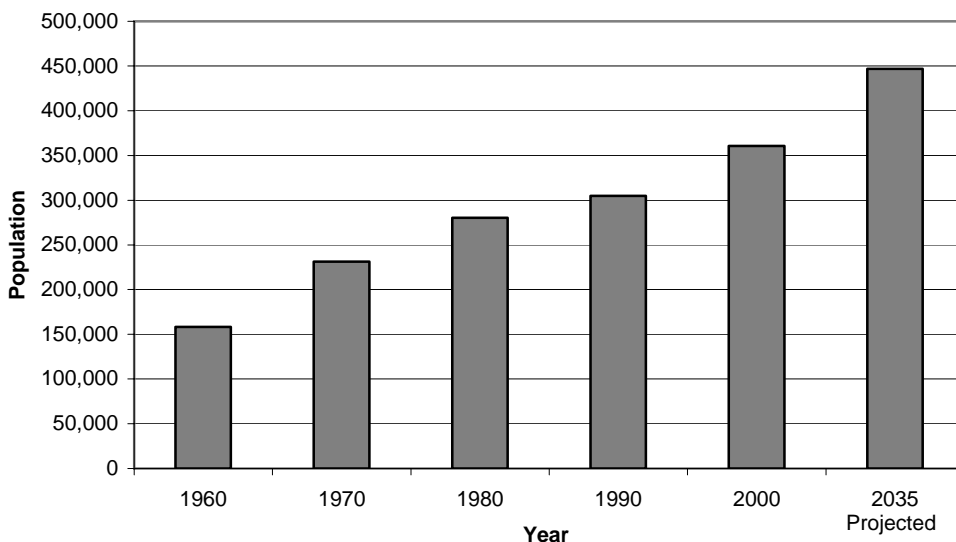
Municipality		2005 Population Estimates	Municipality		2005 Population Estimates
Town of:	Brookfield	6,379	Village of:	Big Bend	1,285
	Delafield	8,286		Butler	1,835
	Eagle	3,492		Chenequa	586
	Genesee	7,542		Dousman	1,808
	Lisbon	9,733		Eagle	1,772
	Merton	8,347		Elm Grove	6,234
	Mukwonago	7,482		Hartland	8,365
	Oconomowoc	7,882		Lac La Belle	333
	Ottawa	3,850		Lannon	957
	Summit	5,178		Menomonee Falls	33,939
	Vernon	7,455		Merton	2,376
	Waukesha	8,832		Mukwonago	6,506
				Nashotah	1,372
City of:	Brookfield	39,797		North Prairie	1,855
	Delafield	6,736		Oconomowoc Lake	637
	Muskego	22,427		Pewaukee	8,969
	New Berlin	38,969		Sussex	9,761
	Oconomowoc	13,459		Wales	2,567
	Pewaukee	12,625			
	Waukesha	67,580			
			<b>Waukesha County Total</b>		<b>377,208</b>

Source: Wisconsin Department of Administration

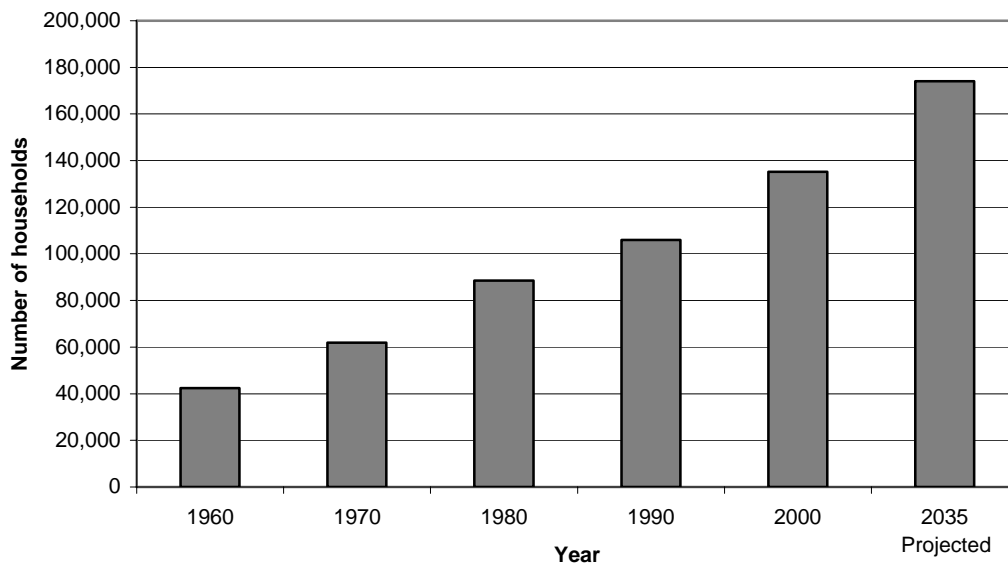
The population and household projections were generated by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) as part of the regional land use planning process. These estimates include natural increases in population (births/deaths) and net in-migration to the county from other areas, and represent the intermediate of three projections prepared by SEWRPC.

The number of households in the County increased by 29,239 households, or 28 percent, from 105,990 households in 1990 to 135,229 households in 2000. This follows increases of 17,438 households during the 1980s, 26,617 households during the 1970s, 19,541 households during the 1960s, and 18,795 households during the 1950s.

**Figure II-2**  
**Historical and Projected Population for Waukesha County: 1960-2035**



**Figure II-3**  
**Historical and Projected Number of Households for Waukesha County: 1960-2035**



The remainder of this chapter will review the natural resource features and land use of the county. It should be noted that impacts on many of these resources have been and will continue to be directly or indirectly influenced by the population data presented above.

## **Geology and Physiography**

Topographic elevation in Waukesha County, as depicted in Map II-2, ranges from approximately 730 feet above mean sea level in the extreme eastern portions of the County along tributaries of the Menomonee River in Brookfield, Elm Grove, and Menomonee Falls, to 1,233 feet at Lapham Peak in the Town of Delafield, a variation of over 500 feet. Most of the high points in the County are located along the Kettle Moraine in three distinct areas: the southern half of the Town of Delafield near Lapham Peak, the southwestern quarter of the Town of Lisbon, and between State Highways 59 and 67 in the Towns of Genesee and Ottawa.

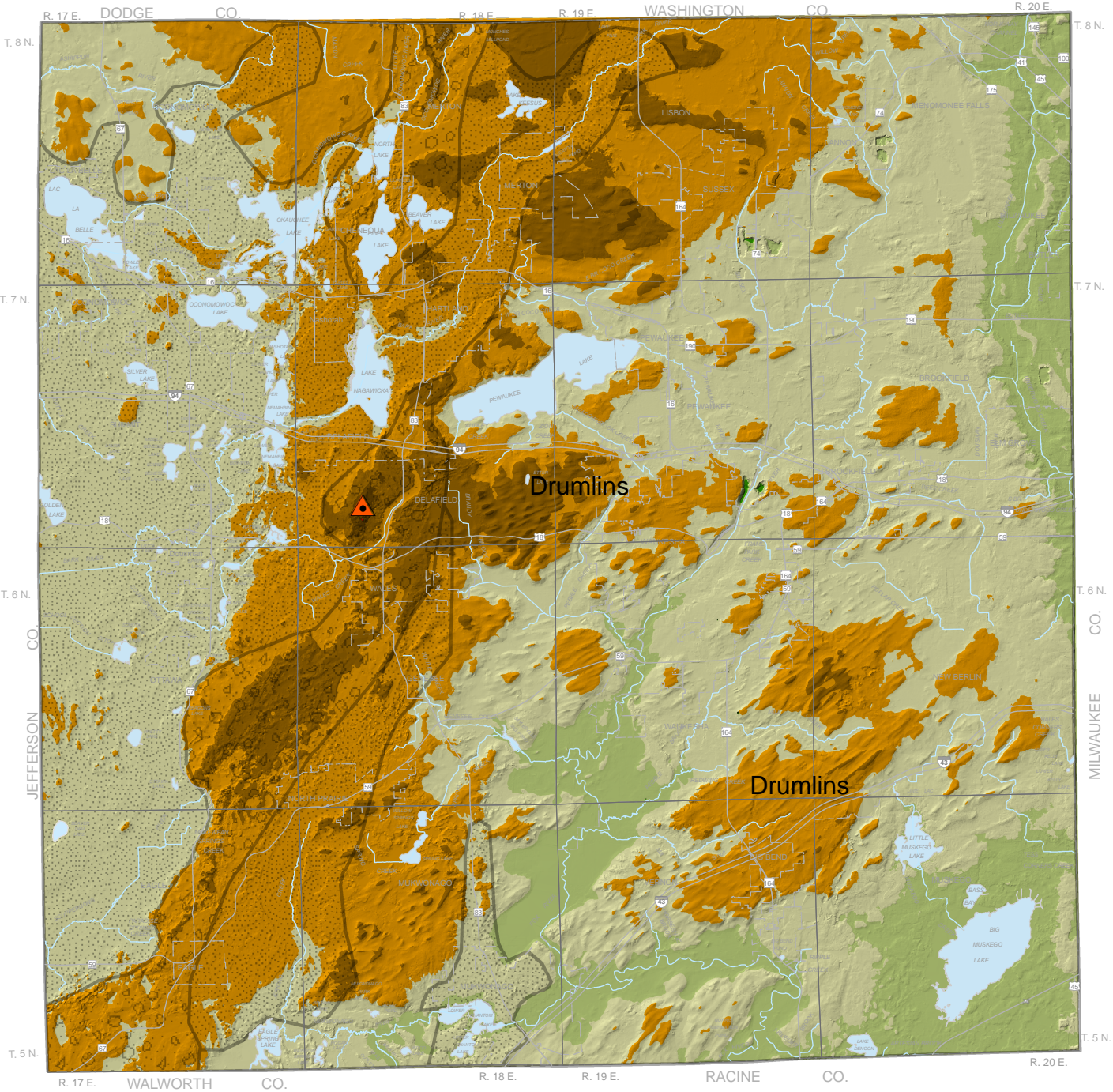
Four major stages of glaciation, the last of which was the Wisconsin stage, ending approximately 10,000 years ago in the State, have largely determined the physiography, topography, and soils of Waukesha County. Map II-2 also shows some of the county's major physiographic features. The dominant physiographic and topographic feature in Waukesha County is the Kettle Moraine, an interlobate glacial deposit formed between the Green Bay and Lake Michigan lobes of the continental glacier that moved in a generally southerly direction from its origin in what is now Canada. The Kettle Moraine, which is oriented in a general northeast-southwest direction across western Washington, Waukesha, and Walworth Counties, is a complex system of kames, or crudely stratified conical hills; kettle holes formed by glacial ice blocks that became separated from the ice mass and melted to form depressions and small lakes as the meltwater deposited material around the ice blocks; and eskers, long, narrow ridges of drift deposited in abandoned drainageways. The remainder of the County is covered by a variety of glacial landforms and features, including various types of moraines, drumlins, kames, outwash plains, and lake basin deposits.

The combined thickness of unconsolidated glacial deposits, alluvium, and marsh deposits overlying bedrock exceeds 100 feet throughout most of the County. Thicknesses are greatest where glacial materials fill the bedrock valleys and in areas of topographic highs formed by end moraines. The most substantial glacial deposits, from 300 to 500 feet thick, are located in the northwestern part of the County in the lakes area and in portions of the Towns of Mukwonago and Vernon, as shown in Map II-3. The thinnest glacial deposits, 20 feet thick or less, are found along an approximately six-mile-wide band traversing the County in a northeasterly direction from the Village of Eagle to the Villages of Lannon and Menomonee Falls.

### **Bedrock Geology**

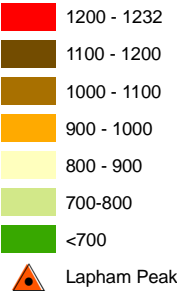
Bedrock topography was shaped by preglacial and glacial erosion of the exposed bedrock. The consolidated bedrock underlying Waukesha County generally dips eastward at a rate of about 10 feet per mile. The bedrock surface ranges in elevation from about 900 feet above mean sea level, at Lapham Peak, to approximately 500 feet above mean sea level in the eastern portion of the County. The bedrock formations underlying the unconsolidated surficial deposits of Waukesha County consist of Precambrian crystalline rocks; Cambrian sandstone; Ordovician dolomite, sandstone, and shale; and Silurian dolomite. Figure II-4 shows a generalized cross-section of the bedrock geology of Waukesha County. The uppermost bedrock unit throughout most of the County is Silurian dolomite, primarily Niagara dolomite, underlain by a relatively impervious layer of Maquoketa shale, which acts as an aquitard – minimizing groundwater movement into the underlying materials. This is discussed further in the groundwater section. In some of the pre-Pleistocene valleys in the southwestern and central portions of the County, however, the Niagara dolomite is absent and the uppermost bedrock unit is the Maquoketa shale.

# Map II-2 Topographic and Physiographic Characteristics of Waukesha County

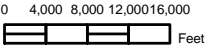
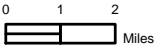
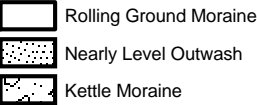


## Legend

### Elevation (In Feet)

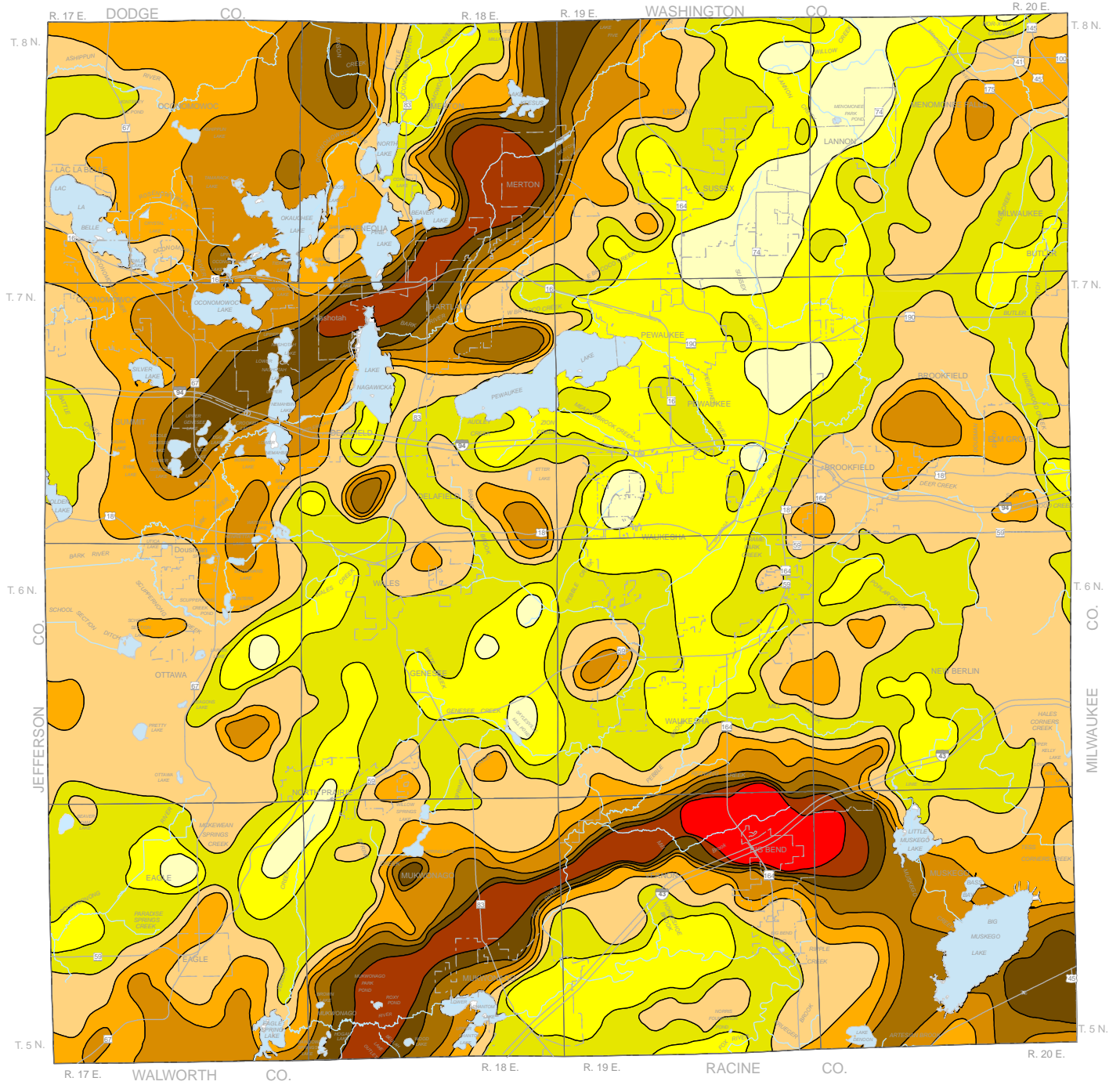


### Physiography

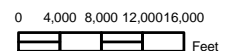
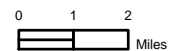
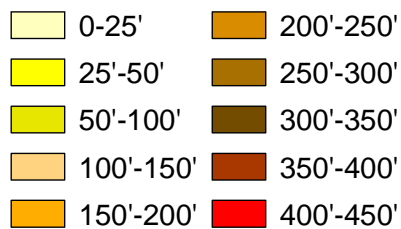




# **Map II-3** **Generalized Depth to Bedrock for Waukesha County**



## **Legend**

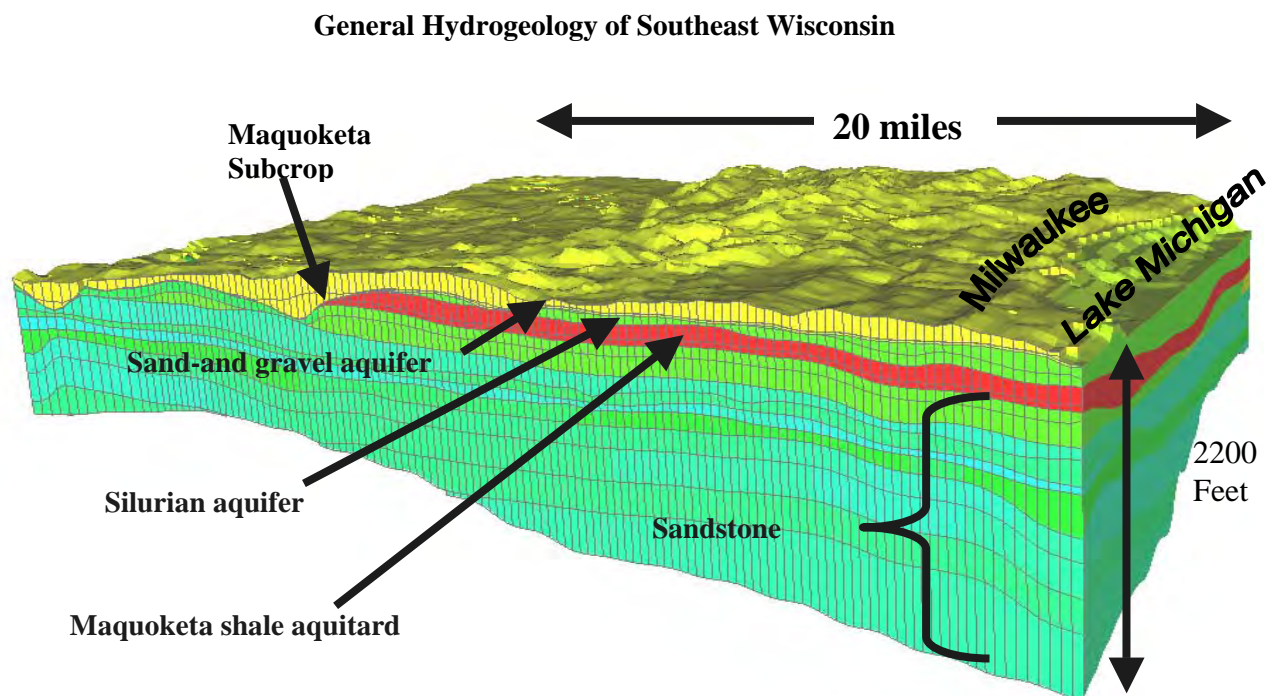


Source: WGNHS, SEWRPC & Waukesha County



Geologic properties can influence the manner in which land is used, since geologic conditions, including the depth to bedrock, can affect the cost and feasibility of building site development and provision of public facilities and infrastructure. As noted in the following sections, the geology of the county can also play a significant role in resource management issues, such as groundwater and mineral extraction.

**Figure II-4**

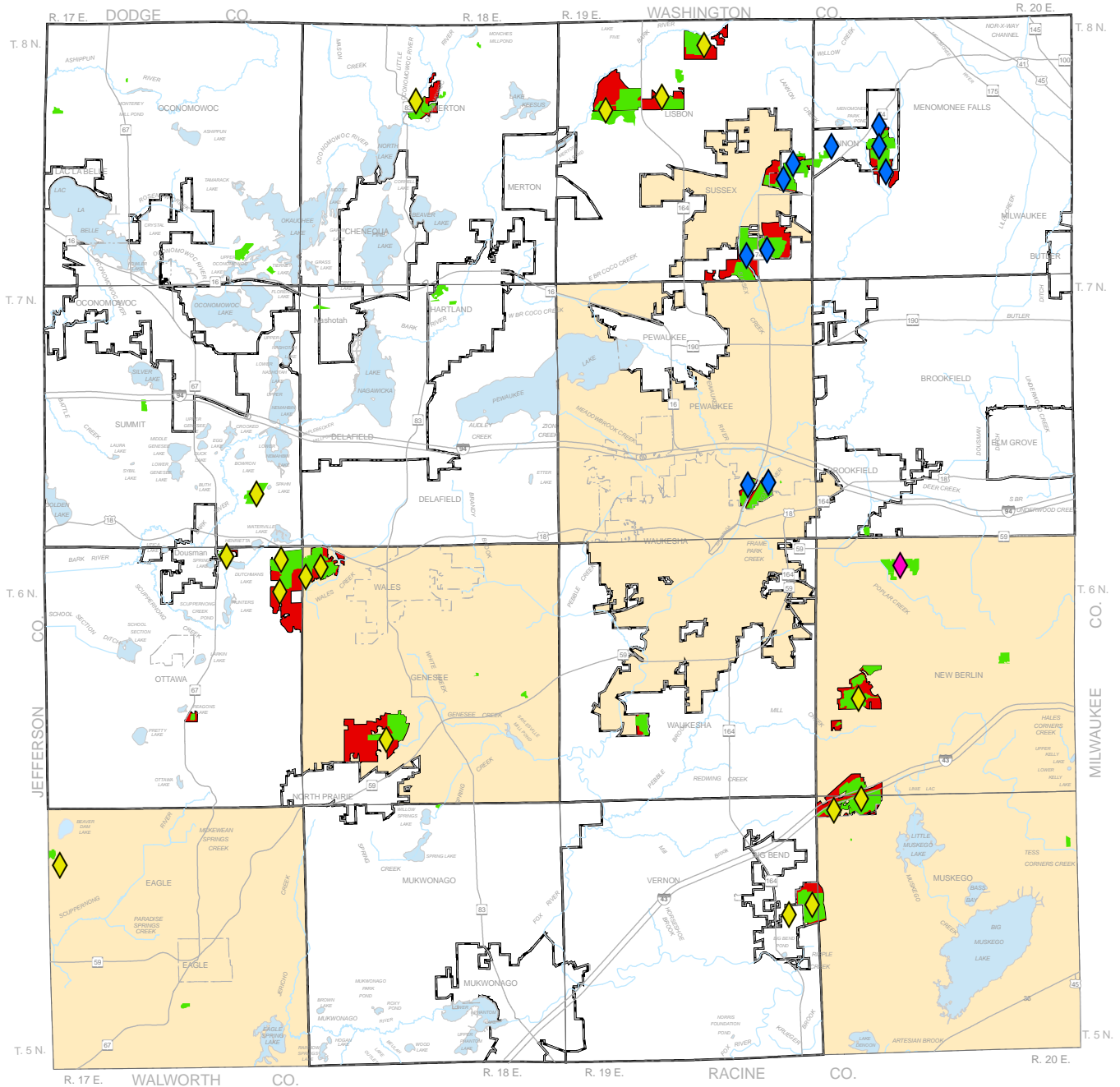


#### Nonmetallic Mineral Extraction in Waukesha County

In the case of potential mineral extraction areas, the geologic attributes of the County are a valuable and irreplaceable resource. Local land use planning efforts have recognized this fact by planning for future mine expansions and incorporating code provisions to avoid land use conflicts. The Waukesha County Mineral Extraction Advisory Committee (MEAC) was established in the mid-1990's to help facilitate these efforts.

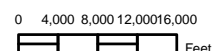
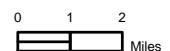
In 2000 extractive land use in Waukesha County totaled about 4000 acres, or approximately 1.1 percent of the total area of the county. This area consists primarily of lands devoted to the extraction of sand, gravel and stone but also includes lands formerly used for such purposes and which lay idle in 2000. By state mandate, Waukesha County adopted a nonmetallic mine reclamation ordinance in 2001 that required new and existing mines to prepare and implement a reclamation plan. These reclamation plans will be implemented over a period of many years depending on the expected operational lifespan of the quarry or gravel pit. At present there are 28 permitted nonmetallic mining operations in the county, 16 issued by the LRD and 12 by other communities that have adopted reclamation ordinances. The general location and type of mining operation are shown in Map II-4. In total, there are currently 10 active limestone quarries, 17 sand and gravel pits and one peat mining operation in the county.

# **Map II-4** **Nonmetallic Mineral Extraction Sites in Waukesha County: 2005**



## **Legend**

- ◆ Limestone Quarries
- ◆ Sand & Gravel
- ◆ Peat Mine
- Year 2000 Extractive Areas
- Future Extractive Areas
- Regulatory Authority - County
- Regulatory Authority - Local



Source: SEWRPC & Waukesha County

## Soils

Soil properties exert a strong influence on the manner in which land is used, since they affect the costs and feasibility of building site development and provision of public facilities. Soils are also an invaluable resource for agricultural and landscaping purposes. Soil surveys have provided definitive data on the physical, chemical, and biological properties of the soils and interpretations of the soil properties for planning, engineering, agricultural and resource conservation purposes. Below is a review of some of these features relating to urban and agricultural uses in Waukesha County.

### Agricultural Use

Although development pressure remains high in Waukesha County and available cropland is reduced every year, there is still a considerable amount of cropland harvested. Grains, nursery, greenhouse, floriculture and sod, dairy, vegetables, corn silage and hay are the main commodities generating approximately \$31.7 million in sales in 2002. According to the 2002 Census of Agriculture, there were 762 farms in Waukesha County in 2002. A farm is defined as “any establishment from which \$1,000 or more of agricultural products were sold or would normally be sold during the year.” This is down from 817 farms in 1997, a decline of 55 farms or approximately 7 percent. Average farm size has also decreased, going from 142 acres in 1997 to 129 acres in 2002. Even with these declines, in 2002 Waukesha County farmers harvested 26,519 acres of corn, 22,871 acres of soybeans, and 1,073 acres of assorted vegetables. That same year, approximately 4,000 dairy cows on 52 farms produced 75,200,000 pounds of milk, an average of 18,800 pounds per cow. The most current numbers reported in Wisconsin Agricultural Statistics indicate that there are 42 Grade A dairy herds and 0 Grade B dairy herds in Waukesha County.

Most of the remaining large areas suitable for agricultural production are concentrated in the western, south central, and north central portions of the county with scattered cropland elsewhere, as shown in Map II-5. This map was created by using soils information from the Natural Resources Conservation Service (NRCS), 2000 land use data from the Southeastern Wisconsin Regional Planning Commission (SEWRPC), and land parcel data from the Waukesha County Land Information System. Based on SEWRPC land use data, approximately 115,040 acres or about 31 percent of the county was in agricultural uses in 2000. Map II-5 subtracted off subdivision and condominium plats that were recorded up to March 2005, which reveals that approximately 104,475 acres or 28 percent of the county is now in agricultural uses. It should be noted that significant additional land conversions have occurred since 2000 that may still be shown as agricultural land on this map. These areas can only be accounted for through an updated land use inventory, which is not yet available for 2005. Map II-5 also shows where Class I, II and III agricultural soils are presently found within those agricultural land uses shown.

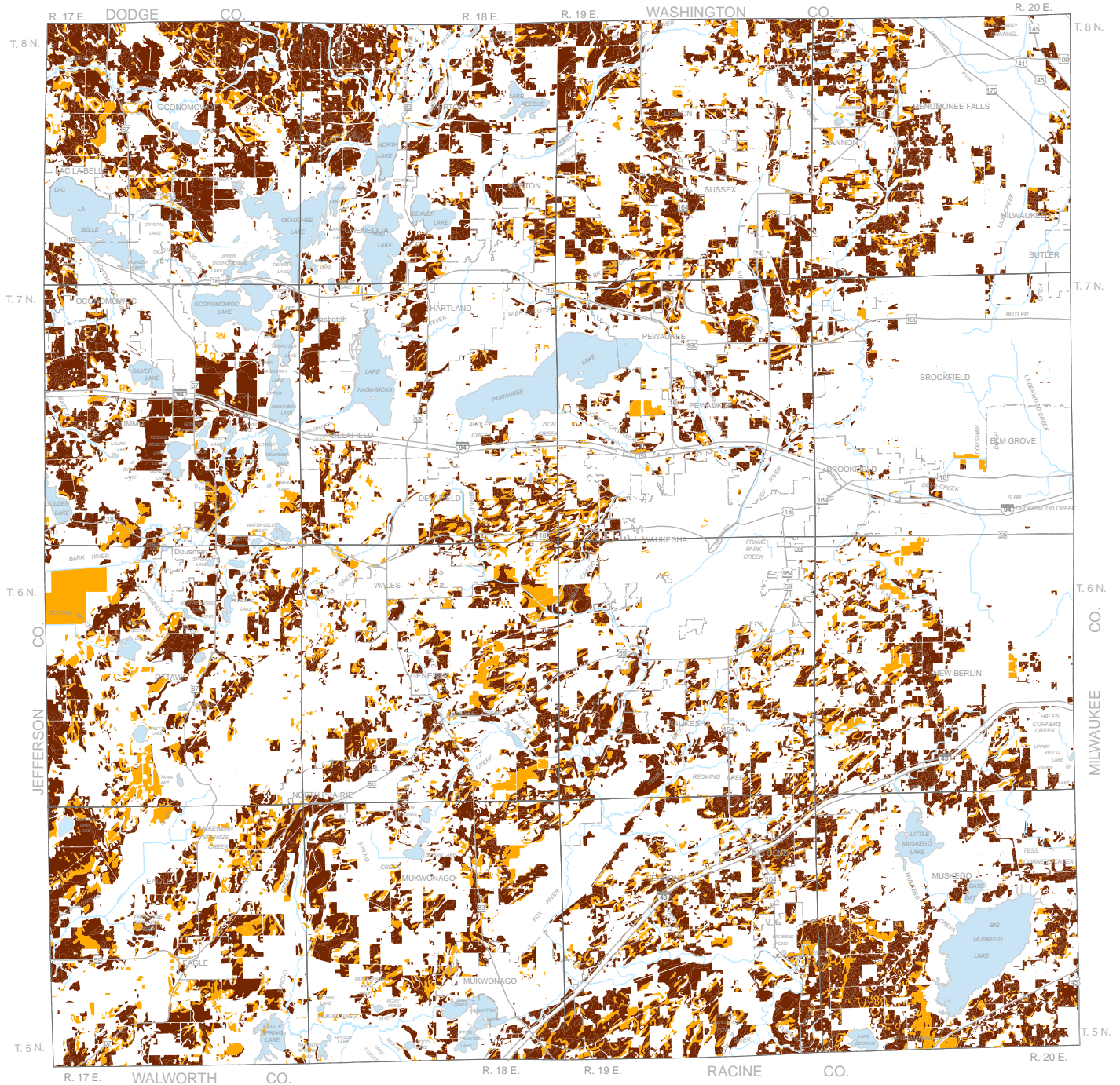
### Soil Erosion Rates

Soils vary dramatically across the landscape. In Waukesha County nearly 150 different soil map units have been identified. Soils also vary in their individual susceptibility to erosion depending on a number of factors including: parent material, vegetative cover, and position on the landscape. Tolerable soil loss or “T” for a particular soil is the maximum average rate of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely (ATCP 50.01(16)). In Waukesha County “T” values for the different soil types range from 2-5 tons per acre per year.

For years, conservationists have used a mathematical formula to estimate the amount of soil lost annually from sheet and rill erosion on cropland. The Universal Soil Loss Equation (USLE) takes into consideration the following factors: rainfall, slope, slope length, soil erodibility, crop rotations and crop practices to arrive at an estimate of soil loss. The Revised Universal Soil Loss Equation version 2



# **Map II-5** **Agricultural Use and Classification of Soils for Waukesha County**

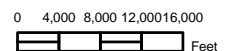
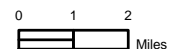


## **Legend**

- Class I & II Soils
- Class III Soils

*Note: Agricultural land use data from 2000 SEWRPC inventory. All subdivisions and condominium plats recorded up to March 2005 have been removed.*

Source: NRCS, SEWRPC & Waukesha County



(RUSLE2) is the newest mathematical model also used for soil erosion calculations. It is a software model that incorporates additional years of research in to the soil loss predictions it calculates and is the model prescribed for conservation planning under ATCP 50. To determine average soil erosion rates in the county, the Land Resources Division conducted its first Transect Survey in the spring of 1999. Normally, this type of survey collects soil loss information for individual cropland fields randomly selected in 0.5-mile intervals along a predetermined driving route in rural areas. However, due to the amount of development in Waukesha County, the interval needed to be shortened to every 0.3-miles in order to obtain the necessary number of sample points for a statistically valid survey. The methodology has been utilized in other states and has proven to be 90% accurate (+/- 5%) in estimating overall soil erosion rates from cropland. The Transect Survey was repeated in 2001. Both results indicated that nearly 90% of the cropland in Waukesha County is less than or equal to "T" or the tolerable soil loss rate. It should be noted however, that "T" is not a water quality standard. An additional 7% of the cropland was determined to be at 1-2 T. The weighted average tolerable soil loss for Waukesha County is 4.2 tons per acre. The weighted average tolerable soil loss is based upon the percentage of sample points in the transect survey with different values for "T". For example, the 2001 Transect Survey conducted in Waukesha County indicated that 2% of the sample points had an average tolerable soil loss (T) of two tons per acre per year, 10% had a T of three, 58% had a T of four, and 30% had a T of five. Survey results also indicated that the average soil loss from cropland was 1.5 tons per acre. This is calculated by examining the soil loss at each sample point in the survey. In 2001 there were 677 sample points examined. Due to the continuing loss of sample points to housing developments, it is uncertain if a Transect Survey can be repeated in future years. It does indicate however, that soil erosion from lands under development is an ongoing issue to be addressed. Studies have shown that an average construction site with no erosion control measures in place erodes 30 tons of sediment per acre. Much of this is delivered to nearby waterways through efficient delivery systems including road ditches and storm sewers.

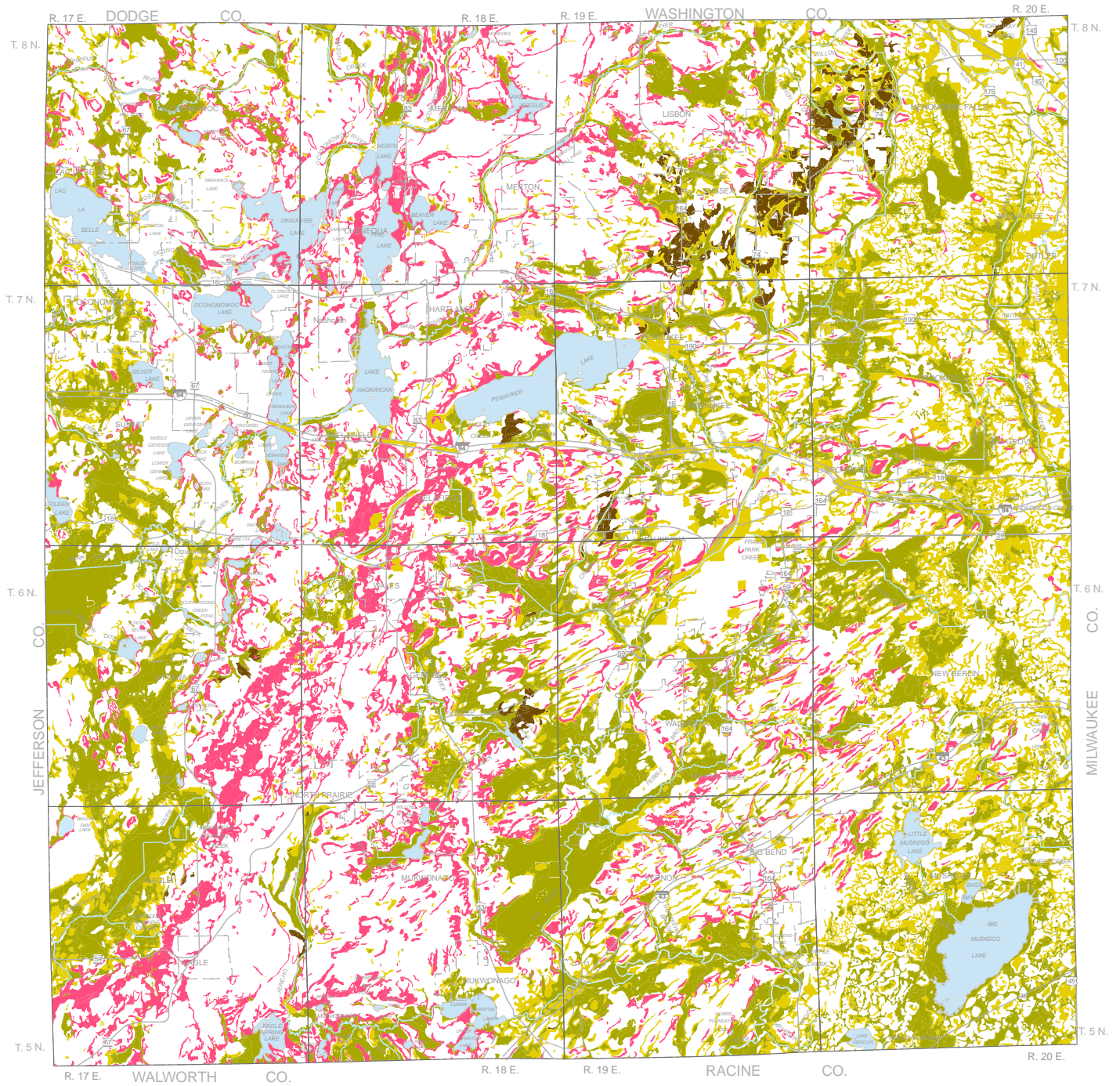
Over the years, several programs at the state and federal level have been successful in getting agricultural landowners to do conservation planning for soil loss reduction. These programs include the Oconomowoc River, Upper Fox River, and Muskego-Wind Lakes Priority Watersheds, the Farmland Preservation Program, and the 1985 Federal Farm Bill with its provisions for Highly Erodible Land (HEL) determinations and the Conservation Reserve Program (CRP). It is believed that these program efforts have contributed to the high percentage of farmland currently within tolerable soil erosion rates.

### Soil Limitations for Development

Map II-6 shows the primary soil features that present limitations for land development, including depth to water table and bedrock and steep slopes. Hydric soils generally have seasonal depth to water table of 1 foot or less and are capable of supporting wetland vegetation. A more detailed definition is provided in Appendix A. Poorly drained soils have seasonal depth to water table of 3 feet and are concentrated on the eastern part of the county where many of the soils have a high clay content, often causing a perched water table condition. Shallow water table conditions risk groundwater contamination from on-site septic systems and could cause wetness problems for dwellings with basements. Shallow bedrock conditions pose higher construction costs for basements and also risk groundwater contamination from on-site septic systems because of the lack of a filtering soil layer. Steep slopes represent possible increased grading costs and higher risks for soil erosion during land development activities. Note that steep slopes are concentrated near the Kettle Moraine area. Shallow bedrock is concentrated near the northeast part of the county, where a number of quarry operations are also located, as noted earlier.

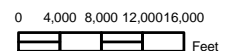
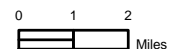


## Map II-6 Soil Limitations for Development



### Legend

- Hydric Soils
- Poorly Drained Soils
- Bedrock < 6'
- Slopes > 12%



Source: NRCS, SEWRPC & Waukesha County

## Woodlands & Wetlands

### Woodlands

Woodlands have both economic and ecological value and can serve a variety of uses providing multiple benefits. Located primarily on ridges and slopes and along streams and lakeshores, woodlands provide an attractive natural resource, accentuating the beauty of the lakes, streams, and the topography of the County. Under balanced use and sustained yield management, woodlands can, in many cases, serve scenic, wildlife, educational, recreational, environmental protection, and forest production benefits simultaneously. In addition to contributing to clean air and water, groundwater recharge and soil conservation, woodlands contribute to the maintenance of a diversity of plant and animal life and provide for important recreational opportunities.

According to the land use inventory prepared by SEWRPC in 2000, woodlands covered approximately 28,931 acres or about 7.7 percent of the County as shown in Table II-7. As indicated on Map II-7, these woodlands exist in large contiguous areas along the Kettle Moraine in the western half of the County and in scattered small areas throughout the remainder of the County.

### Wetlands

Wetlands perform an important set of natural functions, which make them particularly valuable resources lending to overall environmental health and diversity. Wetlands contribute to the maintenance of good water quality by serving as traps that retain nutrients and sediments, thereby preventing them from reaching streams and lakes. They act to retain water during dry periods and hold it during flooding events, thus keeping the water table high and relatively stable. Some wetlands provide seasonal groundwater recharge or discharge. Those wetlands that provide groundwater discharge often provide base flow to surface waters. They provide essential breeding, nesting, resting, and feeding grounds and predator escape cover for many forms of fish and wildlife. These attributes have the net effect of improving general environmental health; providing recreational, research, and educational opportunities; maintaining opportunities for hunting and fishing; and adding to the aesthetics of an area.

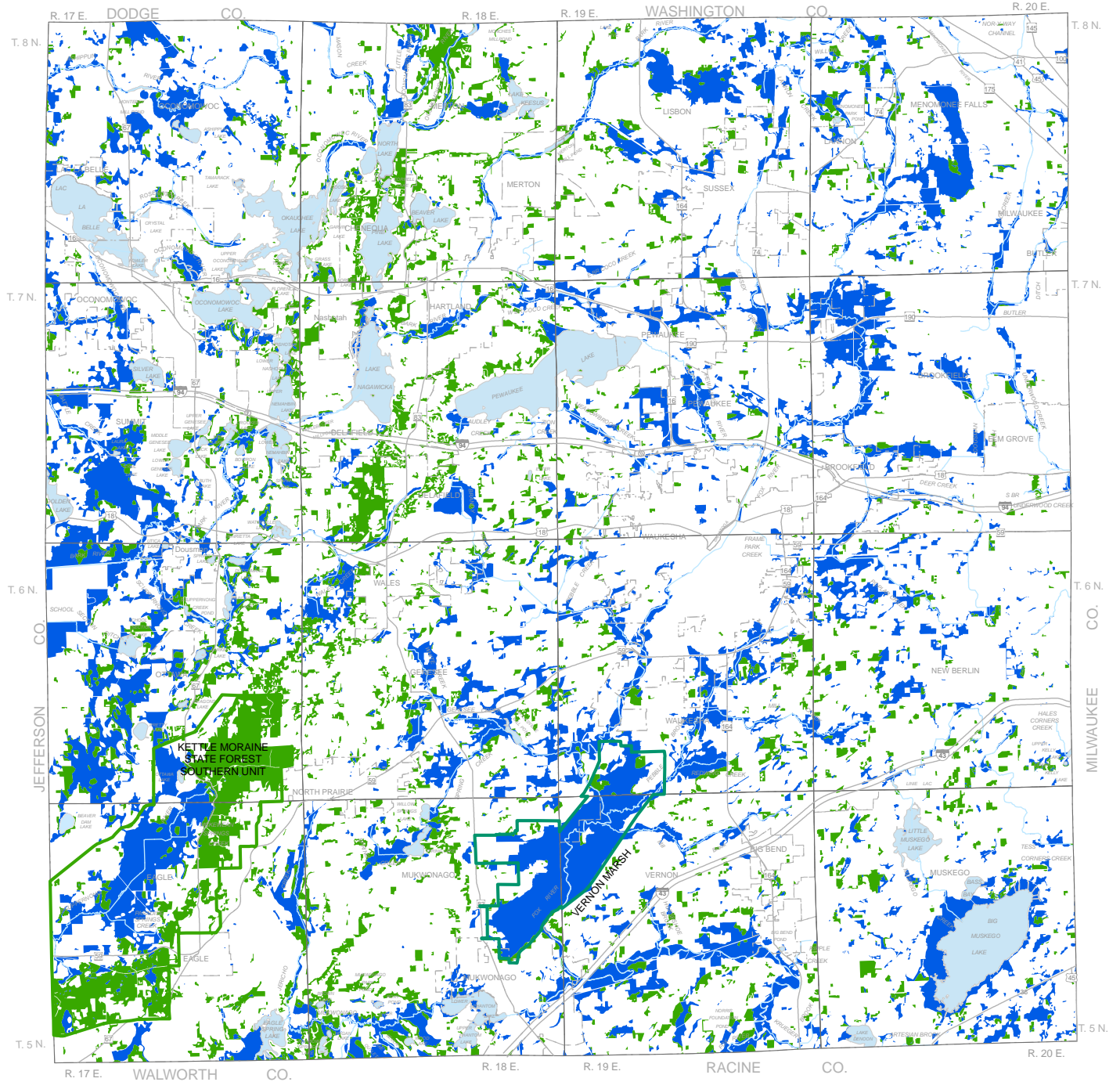
Wetlands pose severe limitations for urban development. In general, these limitations are related to the high water table, and the high compressibility and instability, low bearing capacity, and high shrink-swell potential of wetland soils. These limitations may result in flooding, wet basements, unstable foundations, failing pavements, and failing sewer and water lines. Moreover, there are significant and costly onsite preparation and maintenance costs associated with the development of wetland soils, particularly in connection with roads, foundations, and public utilities. As indicated on Map II-7, wetlands are scattered throughout the County and total approximately 52,661 acres or about 14 percent of the County. See Table II-7. Most of these areas are regulated under state and local codes that restrict development.

### Environmental Corridors and Isolated Natural Resource Areas

The most important elements of the natural resource base of the County, including the best remaining woodlands, wetlands, prairies, wildlife habitat, surface water and associated shorelands and floodlands, and related features, including existing park and open space sites, scenic views, and natural areas and critical species habitat sites, occur in linear patterns in the landscape, termed “environmental corridors.” The most important of these have been identified as “primary environmental corridors,” which are by definition at least two miles long, 200 feet wide, and 400 acres in area. Primary environmental corridors are generally located along river and major stream valleys, around major inland lakes, and in the Kettle Moraine. The preservation of these corridors is considered essential to the overall environmental quality



## Map II-7 Major Woodlands and Wetlands of Waukesha County



### Legend

- Woodlands
- Wetlands



0 1 2  
Miles

0 4,000 8,000 12,000 16,000  
Feet

Source: SEWRPC & Waukesha County

of the County and the maintenance of its unique cultural and natural heritage and natural beauty. Because these corridors are generally poorly suited for urban development owing to soil limitations, steep slopes, or flooding potential, their preservation will also help to avoid the creation of new environmental and developmental problems.

In addition to primary environmental corridors, other concentrations of natural resources—referred to as “secondary environmental corridors” and “isolated natural resource areas”—have been identified as warranting strong consideration for preservation. Secondary environmental corridors contain a variety of resource features and are by definition at least one mile long and 100 acres in area. Isolated natural resource areas are concentrations of natural resources of at least five acres in size and 200 feet in width that have been separated from the environmental corridor network by urban or agricultural uses.

## **Groundwater Resources**

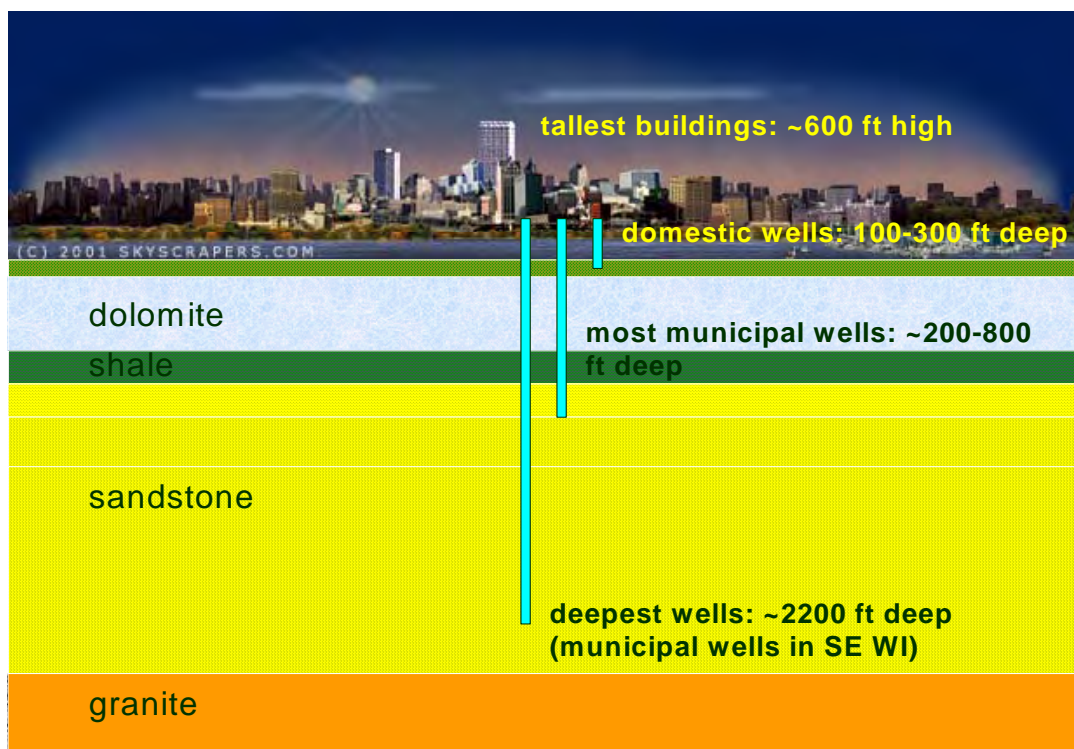
Groundwater is a vital natural resource of Waukesha County, which not only sustains lake levels and wetlands and provides the perennial base flow of the streams, but also is a major source of water supplies. In general, the County has an adequate supply of groundwater to support its growing population, agriculture, commerce, and a viable, diverse industry. However, overproduction and water shortages may occur in areas of concentrated development and intensive water demand, especially in the sandstone aquifer and in selected areas served by the shallow aquifers. The amount, recharge, movement, and discharge of the groundwater is controlled by several factors, including precipitation, topography, drainage, land use, soil, and the lithology and water-bearing properties of rock units ranging in age from Quaternary to Precambrian.

The Southeastern Wisconsin Regional Planning Commission (SEWRPC), working in cooperation with the U.S. Geological and Natural History Survey, the University of Wisconsin-Milwaukee, the DNR, water supply utilities, and other local units of government, has completed the first two phases of a three phase regional water supply management program. The first two elements, comprising the development of basic groundwater inventories and a groundwater simulation model for the southeastern Wisconsin region, were completed over the past several years. The third element, preparation of a regional water supply management plan, is expected to be completed by the end of 2006. The regional water supply plan will be based upon a design year of 2035 and, when adopted, is likely to lead to future refinements in land use plans across the region. Much of the data provided below is derived from SEWRPC Technical Report 37 entitled, Groundwater Resources of Southeastern Wisconsin. This report provided baseline information regarding groundwater availability and use in southeastern Wisconsin.

### Groundwater Aquifers

Groundwater occurs within three major aquifers that underlie the County. From the land's surface downward, they are: 1) the sand and gravel deposits in the glacial drift; 2) the shallow dolomite strata in the underlying bedrock; and 3) the deeper sandstone, dolomite, siltstone, and shale strata. Because of their proximity to the land's surface and hydraulic interconnection, the first two aquifers are commonly referred to collectively as the “shallow aquifer,” while the latter is referred to as the deep aquifer. The “water table” represents the upper limit of the shallow aquifer, or the beginning of the zone of saturation, and is generally responsible for maintaining stream base flows during dry weather periods and lake water levels in many area lakes. Within most of the County, the shallow and deep aquifers are separated by the Maquoketa shale, which forms a relatively impermeable barrier between the two aquifers (see Figure II-4). That shale layer is absent in the far western portion of the County. Figure II-5 depicts the typical well depths as they relate to the groundwater aquifers.

**Figure II-5  
Relative Well Depths for Waukesha County**



Source: SEWRPC

### Groundwater Use

The importance of groundwater as a source of water supply in Waukesha County and Southeastern Wisconsin can be shown by analyzing water-use data. According to estimates by the U.S. Geological Survey, water users in the Southeastern Wisconsin Region used about 324 million gallons per day (mgd) of water from surface and groundwater sources in 2000, not including water used for thermoelectric-power production (see Table II-2). From this amount, 228 mgd, or about 70 percent, was withdrawn from surface water sources, primarily Lake Michigan; and 96 mgd, or about 30 percent, from groundwater (see Table II-3). In Waukesha County, nearly all of the water supply has historically been obtained from the groundwater system. This has recently changed somewhat with the conversion of the eastern portion of the Village of Menomonee Falls, the Village of Butler, and the eastern portion of the City of New Berlin to Lake Michigan water over the period of 1999 to 2005. Groundwater use and total water use in Waukesha County have risen steadily since 1985, increasing by about 36 percent over the period 1985 to 2000.



**Table II-2**  
**Estimated Use of Water in Southeast Wisconsin: 2000**  
(In million gallons per day)

County	Domestic	Agricultural	Irrigation	Industrial	Commercial	Public Use and Losses	Total
Kenosha .....	7.02	0.18	0.25	4.44	2.95	3.89	18.73 <sup>a</sup>
Milwaukee .....	54.06	0.01	0.81	57.92	33.14	43.60	189.54 <sup>b</sup>
Ozaukee .....	4.11	0.32	0.51	1.88	1.08	1.42	9.32 <sup>c</sup>
Racine .....	13.00	1.80	2.16	10.82	5.22	6.87	39.87
Walworth .....	5.13	2.16	0.66	3.20	1.67	2.20	15.02
Washington .....	5.64	0.62	0.31	2.55	1.84	2.42	13.38 <sup>d</sup>
<b>Waukesha .....</b>	<b>14.12</b>	<b>0.27</b>	<b>2.68</b>	<b>9.10</b>	<b>5.07</b>	<b>6.67</b>	<b>37.91</b>
Total	103.08	5.36	7.38	89.91	50.97	67.07	323.77
Percent of Total	31.80	1.70	2.30	27.80	15.70	20.70	100.00

<sup>a</sup>Does not include 15.2 mgd of thermo-electric use.

<sup>b</sup>Does not include 1,867.6 mgd of thermo-electric use.

<sup>c</sup>Does not include 118.8 mgd of thermo-electric use.

<sup>d</sup>Does not include 2.4 mgd of thermo-electric use.

Source: B.R. Ellefson, G.D. Mueller, and C.A. Buchwald, U.S. Geological Survey, "Water Use in Wisconsin, 2000."

**Table II-3**  
**Trends in Reported Water Use in Southeastern Wisconsin: 1979-2000**  
(In million gallons per day)

County	1979			1985			1990			2000		
	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total
Kenosha	17.81	3.42	21.23	17.87	2.54	20.41	20.41	2.56	22.97	16.04	2.69	18.73
Milwaukee	172.47	10.18	182.65	213.26	9.91	223.17	184.96	6.17	191.13	183.22	6.32	189.54
Ozaukee	1.19	6.66	7.85	1.15	6.33	7.48	1.43	6.66	8.09	1.52	7.80	9.32
Racine	22.55	7.69	30.24	22.55	7.28	29.83	29.32	8.85	38.17	26.24	13.63	39.87
Walworth	0.14	9.89	10.03	1.16	9.14	10.30	0.08	16.07	16.15	0.07	14.95	15.02
Washington	0.15	10.11	10.26	0.06	9.37	9.43	0.08	9.76	9.84	0.08	13.30	13.38
<b>Waukesha</b>	<b>0.02</b>	<b>33.37</b>	<b>33.39</b>	<b>0.12</b>	<b>27.84</b>	<b>27.96</b>	<b>0.04</b>	<b>30.78</b>	<b>30.82</b>	<b>0.35</b>	<b>37.56</b>	<b>37.91</b>
Total	214.33	81.32	295.65	256.17	72.41	328.58	236.32	80.85	317.17	227.52	96.25	323.77
Percent of Total	72.5	27.5	100.0	78.0	22.0	100.0	74.5	25.5	100.0	70.3	29.7	100.0

**NOTES:** GW = Ground water source; SW = Surface water source. The trends are based on currently available data, but the sources of information and accuracy of data may vary from one reporting period to another. The USGS obtains most of water-use data from files of state agencies, and makes estimates for categories for which data are not reported (private domestic and agricultural uses). Water used for thermoelectric power is not included.

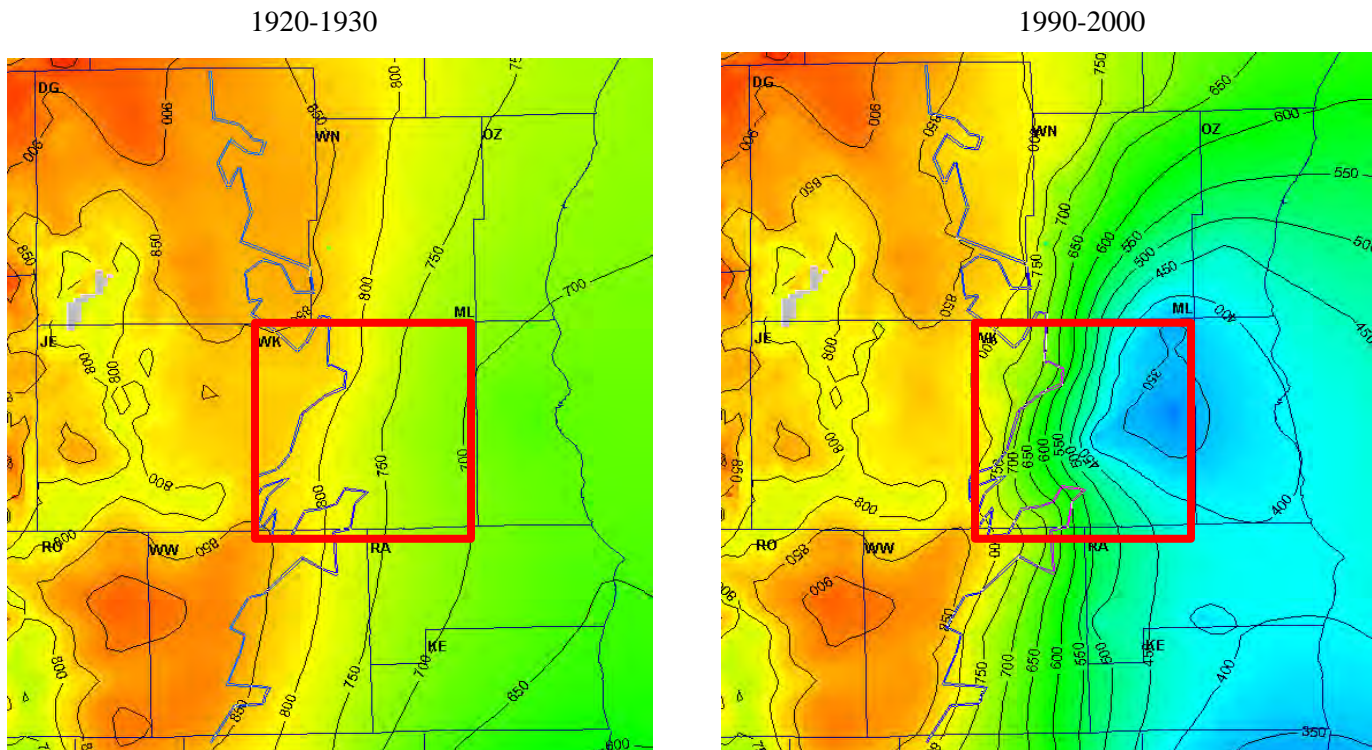
Source: SEWRPC, U.S. Geological Survey, 2000.

## Groundwater Availability

Recharge to groundwater is derived almost entirely from precipitation. Much of the groundwater in shallow aquifers originates from precipitation that has fallen and infiltrated within a radius of about 20 or more miles from where it is found. The deeper sandstone aquifers are recharged by downward leakage of water through the Maquoketa Formation from the overlying aquifers or by infiltration of precipitation beyond the western edge of the County where the sandstone aquifer is not overlain by the Maquoketa Formation and is unconfined. On the average, precipitation annually brings about 32 inches of water to the surface area of the County. It is estimated that approximately 80 percent of that total is lost by evapotranspiration. Of the remaining water, part runs off in streams and part becomes groundwater. It is likely that the average annual groundwater recharge to shallow aquifers is 10 to 15 percent of annual precipitation.

To document the utilization of the shallow aquifers in the County, it may be assumed, for example, that, on the average, 10 percent of the annual precipitation reaches groundwater. Then, the average groundwater recharge in the County would be about 88 mgd. As previously noted, the estimated daily use of groundwater in 2000 was about 38 mgd, which is about 43 percent of the total amount of groundwater assumed to be recharged in a given year. This indicates that there is an adequate annual groundwater recharge to satisfy water demands on the shallow aquifer system in Waukesha County on a countywide basis. However, the availability on a localized area basis will vary depending upon usage, pumping system configuration, and groundwater flow patterns.

**Figure II-6**  
**Water Levels in the Sandstone Aquifer in Southeast Wisconsin: 1920-2000**  
(feet above sea level)



Source: SEWRPC

The situation is different for the deep aquifers where withdrawals of groundwater cause supply/demand imbalance in areas of concentrated use of groundwater, which has resulted in the declining potentiometric surface and mining of groundwater. Figure II-6 illustrates the cone of depression that has formed in the deep sandstone aquifer in southeast Wisconsin over the past 80 years due to water use in the region.

Figure II-6 shows that the water table elevation in the deep aquifer has dropped over 350 feet in 80 years and that the direction of groundwater flow has actually reversed, drawing water from Lake Michigan rather than draining toward it as it originally did in the early 1900's. The center of the cone of depression slowly progressed to the west and is now near the eastern border of Waukesha County (Brookfield area). Professor Douglas Cherkauer of the University of Wisconsin-Milwaukee, has estimated how much greater the demand is for groundwater from this aquifer than the available supply for Waukesha County, as shown in Table II-4.

**Table II-4**  
**Estimates of Available Groundwater in Waukesha County: 1999**

Aquifer	Recharge Area (square miles)	Estimated Recharge Rate (inches per year)	Average Daily Recharge (mgd)	Average Daily Demand (mgd)
Shallow	400	3.1	59	3.5
Deep	100	3.1	14.8	31.5

Source: D.S. Cherkauer, 1999

### Radium Concentrations

Certain formations within the Cambrian sandstones in southeastern Wisconsin are known to produce relatively high concentrations of naturally occurring radium, a radioactive metallic element. This naturally occurring radium has been found to exceed U. S. EPA standards in approximately 50 of the 1,300 municipal water supplies in Wisconsin. Most of the water supplies which exceed the radium standard draw water from the deep sandstone aquifer and lie in a narrow band from the Illinois-Wisconsin border through Kenosha, Racine, and Waukesha Counties and north through Green Bay.

Currently, all water systems that exceed the radium standards in Waukesha County have a consent order agreement with the Department of Natural Resources that details how the water systems will come into compliance with the radium standards by the end of 2006. Systems serving the portions of the Cities of Brookfield, Delafield, Muskego, Pewaukee, and Waukesha; the Villages of Eagle, Mukwonago, Pewaukee, and Sussex; and a few private water systems have reported violations of the current radium standard. At the time of this plan, the only water system to come into compliance is the Village of Mukwonago.

### Vulnerability to Contamination

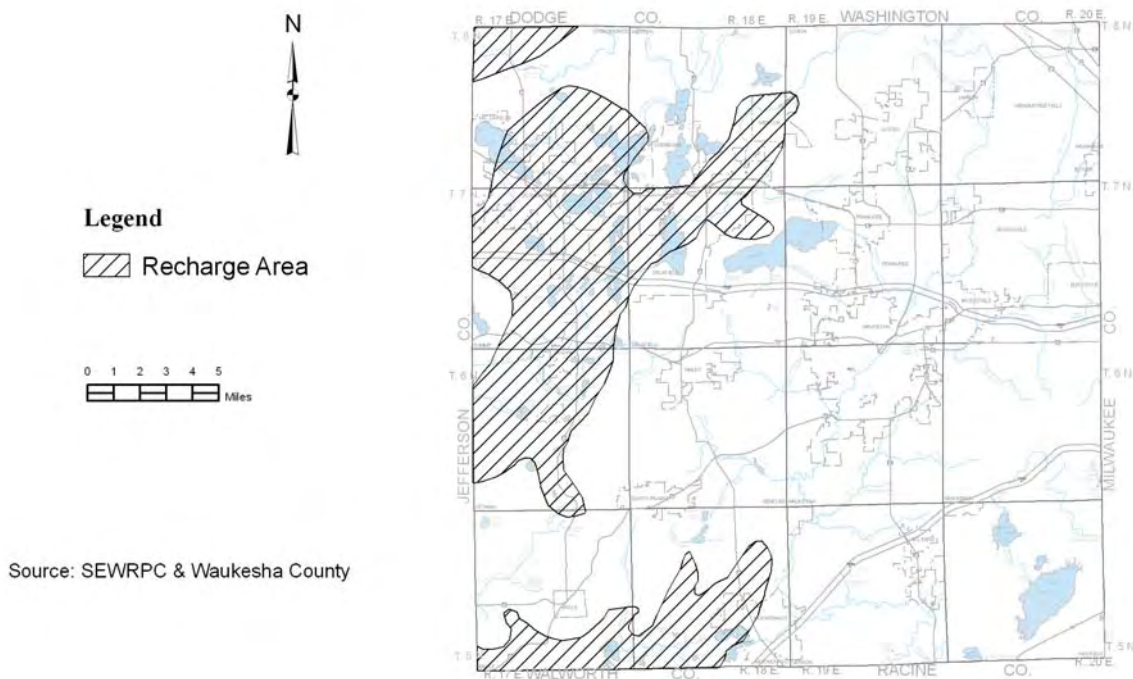
Groundwater quality conditions can through improper construction or management, be impacted by such sources of pollution on the surface as infiltration of storm water runoff, landfills, agricultural fertilizer, pesticides, manure storage and application sites, chemical spills, leaking surface or underground storage tanks, and onsite sewage disposal systems. The potential for groundwater pollution in the shallow aquifer is dependent on the depth to groundwater, the depth and type of soils through which precipitation must percolate, the location of groundwater recharge areas, and the subsurface geology. Most of Waukesha

County exhibits moderate to high potential for contamination of groundwater in the shallow glacial drift and Niagara aquifers. Generally, the areas of the County most vulnerable to groundwater contamination are where both Niagara dolomite and the water table are near the surface.

Compared to the deep aquifer, the shallow aquifers are more susceptible to pollution from the surface because they are nearer to the source in terms of both distance and time, thus minimizing the potential for dilution, filtration, and other natural processes that tend to reduce the potential detrimental effects of pollutants. Isolated cases of contamination have been identified in portions of Waukesha County. Such problems can often be traced to runoff pollution sources, septic system discharges, and chemical spills or leakage.

In the far western portion of the County, there is no confining impermeable layer of rock between the glacial drift and the sandstone aquifer. This is cause for concern in planning for the future development of that area. Urban development adversely affects both the quantity and quality of recharge water, especially where the aquifer is overlaid by outwash, end moraine, or other highly permeable glacial material. An increase in the area of impervious surfaces such as pavement affects the recharge of the sandstone aquifer by diverting larger amounts of precipitation into surface drainage courses as runoff, rather than allowing it to percolate into the ground. Map II-8 shows the approximate area of the county where the impermeable shale layer does not exist and thus, where recharge of the deep sandstone aquifer occurs, feeding municipal water supplies in the eastern portion of the county.

**Map II-8**  
**Approximate Area of Recharge for the Sandstone Aquifer**



## **Drainage Basins and Watersheds**

As shown in Map II-9, Waukesha County river systems drain to three major basins, the Rock River Basin on the western side of the county, the Fox River Basin in the center and the Lake Michigan Basin on the eastern part of the county. The Fox River Basin covers the largest area of the county, encompassing about 58 percent of the total surface area. The Rock River Basin encompasses approximately 34 percent and the Lake Michigan Basin accounts for the remaining 8 percent of the county surface area. The Rock and Fox River Basins both lie west of the sub-continental divide and are part of the Mississippi River drainage area. Everything east of the sub-continental divide, including the Menomonee and Root River Watersheds, are part of the Great Lakes-St. Lawrence River drainage system. The sub-continental divide is critical to the water supply issue noted earlier and sanitary sewer planning. This is because water that is pumped from the Great Lakes system is generally required to be returned after use. For water resource planning purposes, each river basin is further divided into watersheds. There are 10 major watersheds in Waukesha County, as shown in Map II-9. The following sections provide additional detail on the watersheds within each basin. Most of the information presented has been compiled from DNR “State of the Basin” reports.

### **Rock River Basin**

#### **Ashippun River Watershed**

The Ashippun River Watershed lies in Dodge, Washington, and Waukesha counties. It covers 69 square miles, of which approximately 16 square miles or 23 percent of the total watershed is located in northwestern Waukesha County. Agriculture is the primary land use and accounts for 66 percent of the land use in the Waukesha County portion of the watershed, according to the Year 2000 SEWRPC land use inventory.

From its headwaters in a small wetland and agricultural area, the Ashippun River flows at a low gradient (6 ft/mile) southwest through Druid Lake in Washington County to the Rock River in Dodge County. The water is stained light brown by tannic acid and the bottom is largely silt. Other than the Ashippun River, none of the major streams in the watershed are found in Waukesha County.

The Ashippun River is classified as a warm water sport fishery. However, little is known about the Ashippun River’s water quality or whether the river is meeting its full potential.

#### **Bark River Watershed**

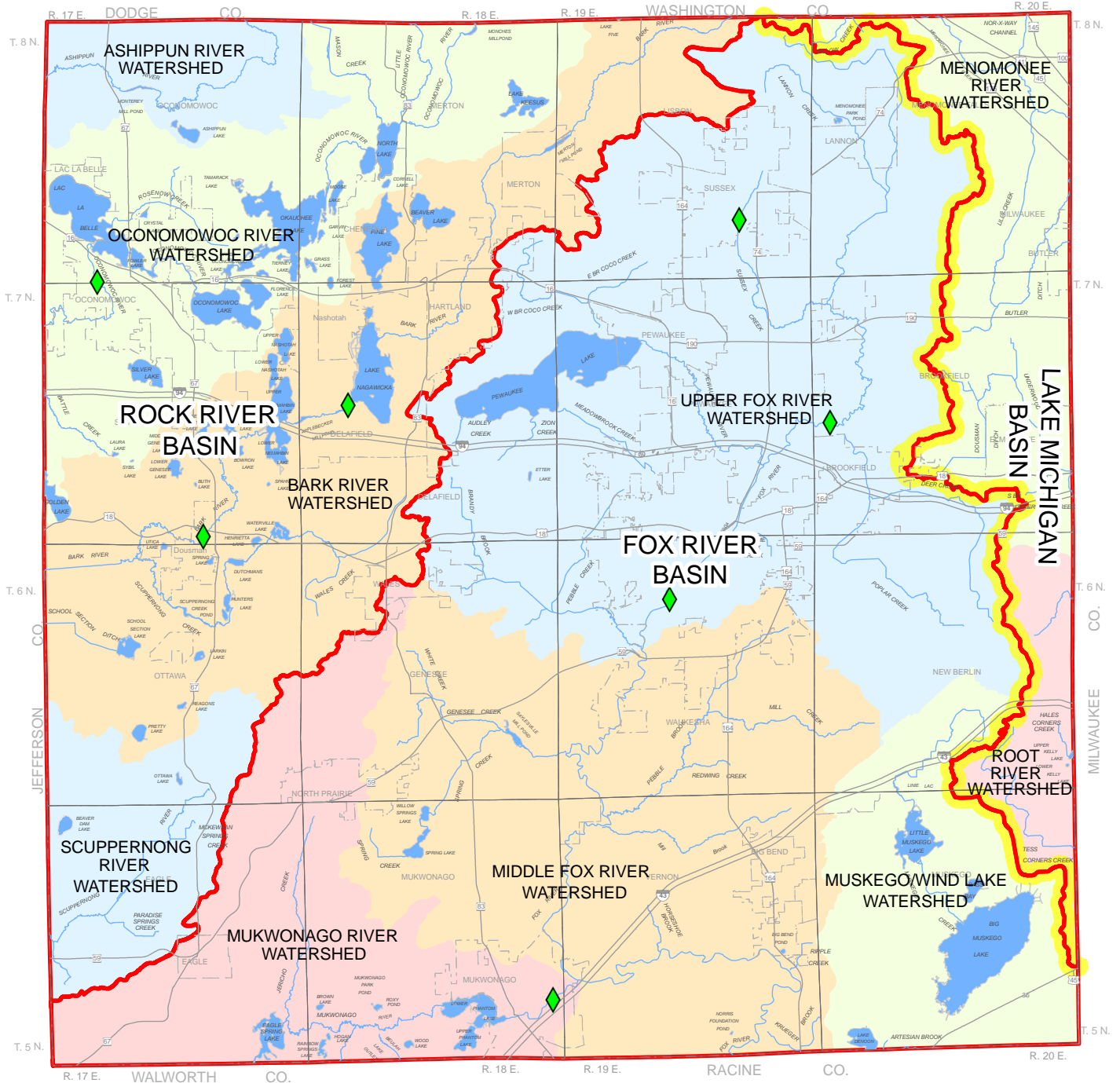
This 186-square mile watershed drains portions of Washington, Waukesha, and Jefferson counties and has many natural lakes, some of them large. About 47 percent of the area is in Waukesha County, 45 percent in Jefferson County and the remainder is in Washington County. Many of the watershed’s lakes are experiencing heavy development pressure or have extensive development around them. While some wetlands have been drained or filled, a significant amount of wetland remains. The greatest threat to the basin’s wetlands is rapid development in Waukesha County.

The watershed is about 44 percent agricultural, but significant rural subdivision development occurs in the Waukesha County portion of the watershed. Of the agricultural lands, about 7 percent have high soil erosion potential. Thus, agriculture use and rural development degrade local surface water quality.

Major streams in the Waukesha County portion of the Bark River watershed include the Bark River, Scuppernong Creek, and Wales Creek. Additional information on each of the streams is included in Table II-5. The Bark River is classified as a warm water sport fishery but is only partially meeting that

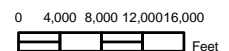
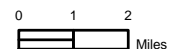


## Map II-9 Watersheds of Waukesha County



### Legend

- River Basin Boundaries
- Subcontinental Divide
- ◆ Sewage Treatment Facilities



Source: SEWRPC, DNR & Waukesha County

use, primarily due to urban and rural polluted runoff entering the river and its tributaries. Most of the urban runoff pollution occurs in Waukesha County, where rapid development of urban and suburban “pockets” occurs along and between its many lakes. There are currently two municipal sewage treatment plants that discharge to the Bark River within Waukesha County, the Village of Dousman and the Delafield-Hartland facility, which discharges just downstream from Nagawicka Lake. Both sites are shown in Map II-9.

Scuppernong Creek rises at the edge of the moraines in central Waukesha County. The creek passes through rural areas much of its length, but subdivisions are developing rapidly in the upstream reach near Wales. Numerous drainage ditch inlets carry agricultural runoff to the stream. There are two impoundments on Scuppernong Creek. Historical records suggest the reach from the headwaters to Waterville Lake supported a viable trout population in the early part of the 20<sup>th</sup> century. Excessive ditching of tributaries and wetlands and the construction of a dam at Waterville, altered stream habitat so it now supports a warm water sport fishery. From the Waterville dam downstream to Dutchman Lake the stream supports a Class I trout fishery due to a large spring that augments flow and lowers stream temperature. Water quality from Dutchman Lake to the old Dousman Millpond is good. There are many springs and the reach supports a warm water sport fishery. Below the Dousman Millpond water quality is poor due to the large sediment load and a much lower gradient. Wales Creek, a small tributary to Scuppernong Creek, is fed by an extensive system of springs; this stream may support a small population of trout.

### **Oconomowoc River Watershed**

The Oconomowoc River Watershed drains approximately 128 square miles encompassing portions of Dodge, Jefferson, Washington, and Waukesha counties. The Waukesha County portion of the watershed is approximately 63 square miles in size representing 49 percent of the watershed. According to the Year 2000 SEWRPC land use inventory, nearly 35 percent of the Waukesha County portion of the watershed is agricultural. Residential land use comprises another 16 percent in Waukesha County and open water from the many lakes and streams accounts for another 13 percent. From its origin in the Town of Richfield in Washington County, the Oconomowoc River flows in a southwesterly direction through six major lakes for approximately 49 miles before entering the Rock River in the Town of Ixonia, Jefferson County.

There is one sewage treatment plant discharge in the Oconomowoc River from the City of Oconomowoc, approximately 2 miles downstream of Lac Labelle. Major lakes in the Waukesha County portion of the watershed include Beaver, Fowler, Lac LaBelle, Keesus, Moose, North, Oconomowoc, Okauchee, Pine and Silver lakes. In addition to the Oconomowoc River, major streams in the Waukesha County portion of the watershed include Battle Creek, Little Oconomowoc River, Mason Creek, and Rosenow Creek.

Rosenow Creek is a designated trout stream and the location of a recent stream restoration project. When the Wisconsin Department of Transportation initiated work on a highway bypass around the City of Oconomowoc, it necessitated moving approximately 1,000 feet of the existing reach of the tributary to Rosenow creek as part of the proposed new roadway. The channel was relocated west of the new roadway and restored to a length of 1,400 feet in the summer of 2004. The stream restoration project was designed and constructed to create a stable and more “natural” channel that is intended to reduce streambank erosion potential, enhance water quality, and improve habitat for wildlife.

Rapid urbanization of the watershed is continuing, especially on and near lakes. The cumulative effect of this urbanization is threatening water quality and hastening the eutrophication of the lakes. The Oconomowoc River was selected as a priority watershed in 1983. A nonpoint source control plan for the Oconomowoc River was completed in 1986. Major objectives for the nonpoint source pollution control plan included protecting the recreational benefits and improving the fisheries of the water resources. In

pursuit of those objectives, landowner contacts were made and conservation plans developed for approximately 3,000 acres of cropland in the Waukesha County portion of the watershed. This resulted in an estimated reduction of soil erosion of approximately 18,500 tons. When the watershed project officially closed in 1995, results seemed mixed on the success of the project. However, spin-off activities which are in part attributable to the watershed project, included formation of new lake districts and the reactivation of another, formation of an environmental foundation and sanitary districts, adoption of construction site erosion control ordinances and the formation of an environmental protection committee.

### **Scuppernong River Watershed**

The Scuppernong River is a tributary of the Bark River in Jefferson County. The watershed is bordered on the southeast by the Kettle Moraine State Forest and lies with in portions of three counties: Jefferson, Walworth, and Waukesha. The predominant land use is agricultural though there is significant public ownership in the state forest and two state wildlife areas with large forested tracts and wetland areas. Other wetland areas have been drained for agriculture. Substantial low-density residential and industrial development is occurring throughout the watershed. According to the Year 2000 SEWRPC land use inventory, approximately 5,723 acres or 38 percent of the Waukesha County portion of the watershed is agricultural. Another 4,416 acres or 29 percent is considered wetland and, 3,429 acres or 22 percent is classified as woodland.

Major streams found in the Waukesha County portion of the watershed include the Scuppernong River and Paradise Springs Creek. The Scuppernong River rises at the edge of the interlobate moraine in the Kettle Moraine State Forest. Reproducing populations of brown trout inhabit the upper reaches, but habitat is impaired by old hatchery ponds that discharge warmer water to the stream. From the area just below the hatchery pond to the Waukesha County line, the stream is a Class III trout stream.

Paradise Springs Creek is a Class II trout stream in Waukesha County. Trout rearing ponds were constructed at the headwaters of the stream several years ago, resulting in the degradation of water quality due to warming of the water. All but one pond have been removed. Segments of the stream are ditched and straightened. Recent habitat work has been done to counteract the effects of previous ditching.

### **Fox River Basin**

#### **Upper Fox River Watershed**

The Upper Fox River Watershed is a 151 square mile drainage area located almost entirely in Waukesha County, with a very small portion (1%) located in Washington County. The Upper Fox River is the principal perennial stream in the watershed. Other significant perennial streams include Brandy Brook, Deer Creek, Pebble Creek, Pewaukee River, Poplar Creek and Sussex Creek. A priority watershed plan was completed in 1994 with stated goals of reducing sediment loading to streams in rural areas by 50-75 percent, reducing phosphorus loading from barnyards by 75 percent, reducing streambank erosion by 50 – 75 percent, and reducing the suspended solids load of urban runoff by 40-90 percent. The watershed project officially ended in 2005 and has resulted in 82 cost-share agreements being signed for conservation practices such as reduced tillage, nutrient management and well decommissioning. On the urban front, a major accomplishment has been the adoption of erosion control and storm water management ordinances by the county and communities within the watershed.

According to the Year 2000 SEWRPC land use inventory, nearly 24 percent of the watershed is mapped as residential land use. Other land use categories include agricultural (23%), wetlands (13%), and transportation related (11%). Commercial and industrial land uses account for another 6 percent of the land area. There are many incorporated municipalities within the watershed including the Cities of Brookfield, Delafield, New Berlin, Pewaukee, and Waukesha. Also included are the Villages of Hartland, Lannon, Menomonee Falls, Pewaukee, Sussex, and Wales. There are three sewage treatment plant

discharges into the Fox River in this watershed. Starting upstream, they are the Village of Sussex, the City of Brookfield and the City of Waukesha, as shown in Map II-9.

The Upper Fox River contains over 80 miles of perennial streams exhibiting a wide range of quality. The Fox River, Frame Park Creek and Zion Creek are listed as impaired waters on the state's 303(d) list. Cocoa Creek, which flows into Pewaukee Lake, has the potential to support a cold water community. The Pewaukee River contains a fairly decent forage and gamefish population. Sussex Creek has been impacted by development and mining in the area. This area is severely impacted by development and by increases in the amount of impervious surfaces. This contributes to the "flashy" nature of the streams in this area. Impoundments contribute to decreased fish migration and degraded water quality.

Another cold-water resource in the Upper Fox River watershed is Pebble Creek. Pebble Creek along with its tributary, Brandy Brook, are listed as trout streams by the DNR. These streams located just west of the city of Waukesha are the location for a flood study and watershed protection planning effort involving the Waukesha County Drainage Board, the Southeastern Wisconsin Regional Planning Commission, the Land Resources Division, representatives from local municipalities in the 20 square mile drainage area, and private consultants. The result will be an action plan intended to protect the local water resources that combines land use planning, storm water management, nonpoint pollution control, agricultural drainage, and floodplain management.

At nearly 2500 acres, Pewaukee Lake is the only lake of significant size in the watershed with a maximum depth of 45 feet and an average depth of 15 feet. It is also one of the largest lakes in southeastern Wisconsin and recognized as one of the top musky lakes in the state. The lake level was naturally controlled until 1838 when a dam was constructed at the lake outlet to power a mill. This resulted in lake levels rising about six feet and the surface area of the lake doubling. Present levels are artificially controlled by a dam at the outlet of the Lake to the Pewaukee River, which then flows about 4.4 miles to its confluence with the Fox River. Water quality data collected over the years indicates fair to very good water quality. However, continued development in the watershed and its subsequent increase in runoff have raised concerns about future pollutant loadings. Efforts to protect and improve the watershed include an active wetland acquisition program by the Lake Pewaukee Sanitary District. This program has resulted in the protection of 258 acres of wetland at a cost of \$511,000.00. The Pewaukee River Partnership is also active in citizen water quality monitoring and other program efforts to improve the condition of these resources.

### **Mukwonago River Watershed**

The Mukwonago River Watershed covers approximately 86 square miles in Jefferson, Waukesha and Walworth counties. Approximately 52 square miles or 61 percent of the watershed area lies within Waukesha County. The Villages of Eagle, Mukwonago, North Prairie and Wales are found within the watershed boundary. The Village of Mukwonago has a wastewater treatment plant discharging into the Mukwonago River.

Rural uses cover most of the land area in the watershed. Agriculture is dominant even in the Waukesha County portion where, according to the Year 2000 SEWRPC land use inventory, agriculture accounts for approximately 36 percent of the land use. Residential land use accounts for another 19 percent of the watershed area in Waukesha County followed by woodlands (15%) and wetlands (9%).

There are nearly 50 miles of perennial streams in the watershed. Jericho Creek in the Town of Eagle is listed as a trout stream as is a portion of the Mukwonago River. In addition, the Mukwonago River is listed as an exceptional resource water in the state. None of the streams in the watershed are listed as impaired on the 303(d) list.



This is perhaps the least disturbed watershed in the Fox River Basin. There are diverse and unique populations of warm water forage fish, game fish, mussels, amphibians and invertebrates. Development of this watershed has increased rapidly in the last few years. Impervious surfaces are becoming more abundant and storm water runoff is increasing. Many of the historic areas that supported agriculture are now supporting suburban housing development. Concern over the impact of development pressures in the watershed has led to the formation of the Friends of the Mukwonago River, a group dedicated to the protection of the river and its watershed.

### **Middle Fox River Watershed**

The Middle Fox River Watershed is the largest of the Fox River Basin watersheds (248 square miles), encompassing portions of Racine and Waukesha Counties, along with small portions of Milwaukee and Walworth Counties. The Waukesha County portion of the watershed covers 86,175 acres or approximately 134 square miles. In Waukesha County, portions of the Cities of Muskego, New Berlin, and Waukesha lie within the watershed, along with the Villages of Big Bend, Mukwonago, North Prairie, and Wales.

Agriculture dominates the rural land use, accounting for over 40 percent of the area. Other rural uses include grasslands (18%), wetlands (14%), and forests (13%). Urban areas comprise nearly four percent of the land cover in the watershed.

There are about 40 miles of major perennial streams in this watershed within Waukesha County. Genesee Creek, Mill Brook, Spring Creek and White Creek are listed as cold-water communities. No streams in the watershed are listed on the 303(d) list. Portions of the watershed are subject to flooding due to the extremely low gradient, and severe flooding was experienced in 1997 and 1999. General threats to stream water quality in this watershed include: construction site erosion; habitat modification; ditching and channelization; temperature elevation and storm water runoff.

Concerns over water resource problems in the Fox River system including navigation, water use conflicts, water quality, flooding and drainage led to the formation of the Southeastern Wisconsin Fox River Commission in 1997 by Wisconsin Act 27 (1997-1999 Budget Bill). This Commission was directed by the enabling legislation to develop an implementation plan to address goals including: 1) Protection and rehabilitation of the water quality of the surface waters and groundwater of the Fox River Basin; 2) protection and enhancement of the recreational use of the navigable waters; and 3) increasing water and boating safety on the same navigable waters. Member of the Commission include city, town, and village officials from communities within the watershed, local residents, representatives from the DNR and SEWRPC, and representatives from Racine and Waukesha Counties. Using grant funds from various sources including Targeted Runoff Management grants, Community Development Block grants, and funds allocated to the Commission, several conservation practices have been installed. These include streambank stabilization projects, grassed waterways, and wetland restoration.

### **Muskego/Wind Lakes Watershed**

The Muskego/Wind Lakes Watershed is actually a small portion (41 square miles) of the Middle Fox River Watershed located in Waukesha, Racine, and Milwaukee Counties. The Waukesha County portion of the watershed encompasses approximately 36 square miles and includes portions of the Cities of Muskego and New Berlin. It was designated a "priority watershed" in 1991 under the Wisconsin Nonpoint Source Water Pollution Abatement Program. Overall goals included the reduction of sediment loadings by 55 percent and reducing phosphorus loading by an average 67 percent. Maintenance of stream base flow conditions was also a stated objective of the plan. The watershed project officially closes at the end of 2005 and in the Waukesha County portion of the watershed has resulted in the development of 36 cost-share agreements primarily for reduced tillage.

Big Muskego Lake is the largest lake in this watershed covering 2,260 acres, but averages only 2.5 feet deep. This lake is undergoing intensive management following the principles of “biomanipulation” to improve water quality not only within the lake, but further downstream to Wind Lake and the Fox River. This project included removing rough fish such as carp and bullheads and establishing desirable rooted and emergent aquatic plants. The plants use the nutrients for growth making them unavailable for excessive algae growth and transport to the water column and further downstream. In addition to the lake rehabilitation project, more than 800 acres of adjacent habitat is being managed cooperatively between the City of Muskego, Wind Lake Management District, the Department of Transportation and the Department of Natural Resources.

Little Muskego Lake appears on the 303(d) list of impaired waters.

### Lake Michigan Basin

#### **Menomonee River Watershed**

The Menomonee River Watershed covers 136 square miles in portions of Washington, Waukesha, and Milwaukee Counties. The Waukesha County portion of the watershed covers about 37 square miles and includes portions of the Cities of Brookfield and Menomonee Falls as well as the Villages of Butler and Elm Grove. The Menomonee River originates in wetlands near the Village of Germantown in Washington County and runs southeasterly for 32 miles before meeting the Milwaukee and Kinnickinnic Rivers in the Milwaukee Harbor.

Nearly all of the land area in the watershed is within incorporated municipalities. According to the Year 2000 SEWRPC land use inventory, nearly 42 percent of the Waukesha County portion of the watershed is residential. Other land uses in Waukesha County include: transportation related (15%), wetlands (8%), and agriculture (7%). Commercial and industrial land uses each contribute another 6 percent of the total land uses respectively.

Stream and wetland modification, urban and rural runoff, construction site erosion and industrial point sources of pollution are the major contributors to degraded water and habitat quality within this watershed. Ninety-six miles of streams are found within the watershed. Over eight miles of stream are listed on the 303(d) list as impaired. Many streams in this watershed have been concrete lined or straightened to convey floodwaters off the land faster. Flooding continues to be a major concern in this watershed.

Following the recent removal of the Falk Corporation Dam and concrete drop structure on the Menomonee River, seasonal runs of Lake Michigan trout and salmon create fishing opportunities in publicly accessible areas up to the Lepper Dam in the Village of Menomonee Falls. Most fish species resident in the streams within this watershed are tolerant of pollution and habitat degradation. Some streams within this watershed are enclosed or diverted under roads for some length which further restricts habitat for aquatic life.

#### **Root River Watershed**

The Root River Watershed is located in portions of Waukesha, Milwaukee, and Racine counties and encompasses 197 square miles. Only about 13 square miles are within Waukesha County covering portions of the Cities of Muskego and New Berlin. According to the Year 2000 SEWRPC land use inventory, residential land use accounts for 46 percent of the land use in the Waukesha County portion of the watershed. Another 15 percent is agricultural and 14 percent is transportation related.

The headwaters begin in west central Milwaukee and eastern Waukesha counties. From there the river flows southeast ultimately emptying into Lake Michigan in the City of Racine. The watershed is heavily

urbanized near the headwaters and mouth. However, the middle portion of the watershed has a large percentage of agricultural land use. This watershed was one of the first Priority Watershed projects funded in the state, with the initial nonpoint source control plan prepared by SEWRPC in 1980 (Planning Report No. 37). Racine County was the Lead Designated Management Agency for the project, which ended in 1990.

Water quality of the 117 miles of rivers and streams in the Root River Watershed ranges from severely degraded to good. The streams in Waukesha County are classified as supporting only a Limited Forage Fish community or Limited Aquatic Life.

## Rivers and Streams

Major streams are perennial streams, which maintain, at a minimum, a small contiguous flow throughout the year except under unusual drought conditions. The major streams in Waukesha County are also presented in Map II-10 and described in more detail in Table II-5 below. Waukesha County has approximately 306 miles of major perennial streams. The longest major streams in the county are the Fox (Illinois) and Bark Rivers, with 50.6 and 29.7 stream miles respectively, as measured using the county Land Information System.

**Table II-5**  
**Major Streams of Waukesha County**

Stream Name	Watershed	Township	Length (miles)	Classification Code(s)
Ashippun River	Ashippun	Oconomowoc	11.1	FAL, AQ-3 (RSH)
Bark River	Bark	Delafield	29.7	FAL, AQ-1 & AQ-2 (RSH)
School Section Ditch	Bark	Ottawa	5.7	FAL
Scuppernong Creek	Bark	Ottawa	12.8	FAL, AQ-2 (RSH)
Wales Creek	Bark	Genesee	2.1	FAL
Butler Ditch	Menomonee	Brookfield	3.9	FAL
Dousman Ditch	Menomonee	Brookfield	2	FAL
Lilly Creek	Menomonee	Menomonee Falls	5.1	FAL
Menomonee River	Menomonee	Menomonee Falls	7.8	FAL, AQ-3
Nor-X-Way Channel	Menomonee	Menomonee Falls	1.3	FAL
Underwood Creek	Menomonee	Brookfield	6.9	Special Variance
Willow Creek	Menomonee	Lisbon	2.3	FAL
Artesian Brook	Muskego-Wind	Vernon	1	FAL
Muskego Creek	Muskego-Wind	Muskego	6.6	FAL
Krueger Brook	Middle Fox	Vernon	2.1	FAL
Ripple Creek	Middle Fox	Vernon	1	FAL
Horseshoe Brook	Middle Fox	Vernon	1.5	FAL
Mill Brook	Middle Fox	Vernon	5.7	COLD, AQ-2 (RSH)
Pebble Brook	Middle Fox	Vernon	8.7	FAL, AQ-3
Redwing Creek	Middle Fox	Waukesha	1.4	FAL
Mill Creek	Middle Fox	Waukesha	5.1	FAL, AQ-3
Genesee Creek	Middle Fox	Waukesha	6.7	ERW, COLD, AQ-2 (RSH)
Spring Creek	Middle Fox	Mukwonago	6	COLD

<b>Stream Name</b>	<b>Watershed</b>	<b>Township</b>	<b>Length (miles)</b>	<b>Classification Code(s)</b>
White Creek	Middle Fox	Genesee	1.4	COLD
Beulah Lake Outlet	Mukwonago	Mukwonago	1.1	FAL
Mukwonago River	Mukwonago	Mukwonago	10.2	ERW, COLD, AQ-1 (RSH)
Jericho Creek	Mukwonago	Eagle	5.8	COLD, AQ-2 (RSH)
Battle Creek	Oconomowoc	Summit	2.8	FAL, 303(d)
Little Oconomowoc	Oconomowoc	Merton	3.5	FAL, AQ-3 (RSH)
Mason Creek	Oconomowoc	Merton	4.5	COLD, 303(d), AQ-2 (RSH)
Oconomowoc River	Oconomowoc	Merton	14.3	ERW, FAL, AQ-3 (RSH)
Rosenow Creek	Oconomowoc	Oconomowoc	3.5	COLD, AQ-3
Hales Corners Creek	Root	New Berlin	1	LAL
Tess Corners Creek	Root	Muskego	5.5	LFF
McKeawn Spring Creek	Scuppernong	Eagle	0.9	COLD
Paradise Springs Creek	Scuppernong	Eagle	1.6	COLD
Scuppernong River	Scuppernong	Eagle	7.4	COLD, AQ-2 (RSH)
Audley Creek	Upper Fox	Delafield	1.2	FAL
Brandy Brook	Upper Fox	Genesee	5	COLD, AQ-3
Deer Creek	Upper Fox	Brookfield	6.6	FAL, 303(d)
Fox (Ill River)	Upper Fox	Waukesha	50.6	FAL, 303(d), AQ-2 (RSH)
Frame Park Creek	Upper Fox	Waukesha	1	LFF, 303(d)
Lannon Creek	Upper Fox	Menomonee Falls	5.4	FAL
Pebble Creek	Upper Fox	Waukesha	6.9	COLD, AQ-3
Pewaukee River	Upper Fox	Pewaukee	6.4	FAL, AQ-3 (RSH)
Poplar Creek	Upper Fox	Brookfield	8	FAL, 303(d), AQ-3 (RSH)
Sussex Creek	Upper Fox	Brookfield	6.6	FAL, 303(d)
Coco Creek (East Br.)	Upper Fox	Pewaukee	2	COLD, AQ-3
Coco Creek (West Br.)	Upper Fox	Pewaukee	4.8	COLD, AQ-3
Zion Creek	Upper Fox	Delafield	1.6	FAL, 303(d)

#### Classification Codes

COLD = Includes surface waters capable of supporting a community of cold water fish and other aquatic life.

FAL = Fish & Aquatic Life. Default classification equivalent to Warm Water Sport Fish Community.

LFF = Limited Forage Fishery. Surface waters capable of supporting only a limited community of forage fish.

LAL = Limited Aquatic Life. Marginal surface waters that support only a limited aquatic life community.

303(d) = Water body appears on the Wisconsin Impaired Waters list.

ERW = An Exceptional Resource Water as defined by Chapter NR102 of the WI Administrative Code.

AQ-1 = Identifies Aquatic Areas of statewide or greater significance.

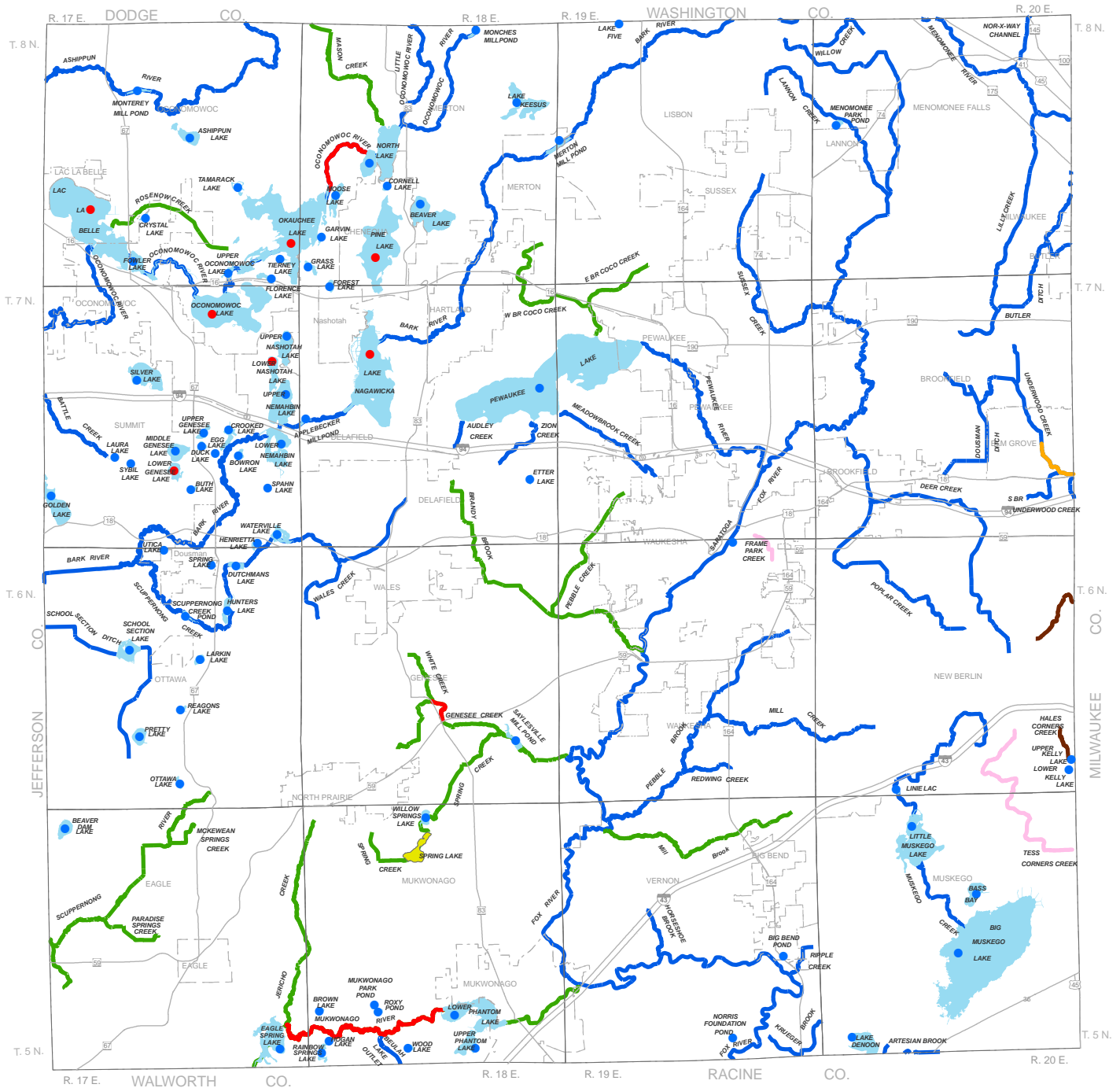
AQ-2 = Identifies Aquatic Areas of countywide or regional significance.

AQ-3 = Identifies Aquatic Areas of local significance.

RSH = Rare Species Habitat. Aquatic areas which support endangered, threatened, or "special concern species" officially designated by the DNR.



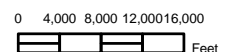
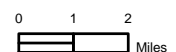
## II-10 Surface Water Resources of Waukesha County



### WATER RESOURCE CLASSIFICATION CODES

- |                                                                                                                                                                                                                     |                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <span style="display: inline-block; width: 20px; height: 10px; background-color: yellow; border: 1px solid black;"></span> Outstanding Resource Water (ORW)                                                         | <span style="display: inline-block; width: 20px; border-bottom: 2px solid pink;"></span> Limited Forage Fish (LFF)   |
| <span style="display: inline-block; width: 20px; border-bottom: 2px solid red;"></span> Exceptional Resource Water (ERW)                                                                                            | <span style="display: inline-block; width: 20px; border-bottom: 2px solid brown;"></span> Limited Aquatic Life (LAL) |
| <span style="display: inline-block; width: 0; height: 0; border-left: 5px solid transparent; border-right: 5px solid transparent; border-bottom: 8px solid blue;"></span> Lake Supports Fish and Aquatic Life (FAL) |                                                                                                                      |
| <span style="display: inline-block; width: 0; height: 0; border-left: 5px solid transparent; border-right: 5px solid transparent; border-bottom: 8px solid red;"></span> Lake Supports Cold Water Species (Cold)    |                                                                                                                      |
| <span style="display: inline-block; width: 20px; border-bottom: 2px solid green;"></span> Cold Water Streams (Cold)                                                                                                 |                                                                                                                      |
| <span style="display: inline-block; width: 20px; border-bottom: 2px solid blue;"></span> Fish and Aquatic Life (FAL)                                                                                                |                                                                                                                      |
| <span style="display: inline-block; width: 20px; border-bottom: 2px solid orange;"></span> Special Variance Waters                                                                                                  |                                                                                                                      |

Source: WDNR, SEWRPC & Waukesha County



## Lakes

Major inland lakes are defined as those with a surface area of 50 acres or larger, a size capable of supporting reasonable recreational use with minimal degradation of the resource. Waukesha County contains all or portions of 33 major lakes with a combined surface area of approximately 14,000 acres, or 21.9 square miles, or about 3.8 percent of the total area of the County. This represents about 38 percent of the combined surface area of the 101 major lakes in the seven-county Southeastern Wisconsin Region, more than any other county in the Region. Thirty of the major lakes are located entirely within the County, while three major lakes, Lake Denoon, Golden Lake, and Lake Five, are located only partly within the County.

In addition to the major lakes, there are 47 other named water bodies with lake characteristics referenced in the DNR publication, "Wisconsin Lakes", PUBL-FM-800 91. The lakes in Waukesha County are presented in Map II-10 and described in Table II-6.

**Table II-6  
Named Lakes in Waukesha County**

Lake	Watershed	Township	Surface Area (acres)	Max. Depth (feet)	Lake Type	Trophic State	Classification Code(s)
Applebecker Millpond	Bark	Delafield	12	5	DG	N/A	FAL
Ashippun*	Ashippun	Oconomowoc	83	40	SP	Mesotrophic	FAL, AQ-2 (RSH)
Bass Bay	Muskego-Wind	Muskego	100	23		Eutrophic	FAL, AQ-3
Beaver	Oconomowoc	Merton	316	49	SP	Mesotrophic	FAL, AQ-3 (RSH)
Beaver Dam	Bark	Eagle	36		SE	Eutrophic	FAL
Big Bend Pond	Middle Fox	Vernon	7	10	SP	N/A	FAL
Big Muskego*	Muskego-Wind	Muskego	2,260	4	DG	Eutrophic	FAL, AQ-2 (RSH)
Brown	Mukwonago	Mukwonago	12	15	SP	N/A	FAL
Buth	Bark	Summit	4	5	SE	N/A	FAL
Cornell	Oconomowoc	Merton	16	12	DG	N/A	FAL
Crooked	Bark	Summit	58	16	DG	Mesotrophic	FAL, AQ-2 (RSH)
Crystal	Oconomowoc	Oconomowoc	17	30		N/A	FAL
Denoon	Middle Fox	Muskego	162	55	SE	Mesotrophic	FAL, AQ-3 (RSH)
Duck	Bark	Summit	12	1	SE	N/A	FAL, AQ-3 (RSH)
Dutchman	Bark	Ottawa	33	43	SE	N/A	FAL, AQ-2 (RSH)
Eagle Spring*	Mukwonago	Eagle	311	8	DG	Mesotrophic	FAL, AQ-2 (RSH)
Egg	Bark	Summit	2	3	SE	N/A	FAL
Etter	Upper Fox	Delafield	11	5	SE	N/A	FAL
Five	Oconomowoc	Merton	102	23	SE	N/A	FAL, AQ-3
Florence	Oconomowoc	Oconomowoc	21	48	SE	N/A	FAL
Forest	Oconomowoc	Merton	41	17	SE	Oligo-mesotrophic	FAL, AQ-3 (RSH)
Fowler*	Oconomowoc	Oconomowoc	99	50	DG	Mesotrophic	FAL, AQ-3
Garvin	Oconomowoc	Merton	17	36	SE	N/A	FAL
Golden	Bark	Summit	250	46	SP	Mesotrophic	FAL, AQ-2 (RSH)
Grass (Mud)	Oconomowoc	Merton	33		SE	N/A	FAL
Henrietta	Bark	Summit	15	7	SE	N/A	FAL, AQ-3 (RSH)
Hogan	Mukwonago	Mukwonago	8	3	SE	N/A	FAL

Lake	Watershed	Township	Surface Area (acres)	Max. Depth (feet)	Lake Type	Trophic State	Classification Code(s)
Hunters	Bark	Ottawa	57	46	SP	Mesotrophic	FAL, AQ-2 (RSH)
Keesus*	Oconomowoc	Merton	237	42	SP	Mesotrophic	FAL, AQ-3
Lac La Belle*	Oconomowoc	Oconomowoc	1,117	45	DG	Mesotrophic	Cold, 303(d), AQ-3
Larkin	Bark	Ottawa	57	4	SP	N/A	FAL, AQ-3 (RSH)
Leota (Laura)	Oconomowoc	Summit	8	11	DG	N/A	FAL
Linnie Lac*	Muskego-Wind	New Berlin	6	6	DG	Eutrophic	FAL
Little Muskego*	Muskego-Wind	Muskego	506	65	DG	Mesotrophic	303(d)
Lower Genesee	Bark	Summit	66	45	SP	Mesotrophic	Cold, AQ-3 (RSH)
Lower Kelly	Root	New Berlin	3	36	SE	Mesotrophic	FAL
Lower Nashotah	Bark	Summit	90	43	SP	Mesotrophic	Cold, AQ-2 (RSH)
Lower Nemahbin	Bark	Summit	271	36	DG	Mesotrophic	FAL, AQ-2 (RSH)
Lower Phantom*	Mukwonago	Mukwonago	433	12	DG	Mesotrophic	FAL, AQ-1 (RSH)
Menomonee Park Pond	Upper Fox	Menomonee Falls	15	50	SP	N/A	FAL
Merton Millpond	Bark	Lisbon	38	8	DG	Eutrophic	FAL, AQ-2 (RSH)
Middle Genesee*	Bark	Summit	109	40	SE	Mesotrophic	FAL, AQ-3 (RSH)
Monches Millpond	Oconomowoc	Merton	16	4	DG	N/A	FAL
Monterey Millpond	Ashippun	Oconomowoc	30	8	DG	N/A	FAL
Moose	Oconomowoc	Merton	81	61	SP	Mesotrophic	FAL, AQ-3 (RSH)
Mukwonago Park Pond	Mukwonago	Mukwonago	1	5	SP	N/A	FAL, AQ-3 (RSH)
Nagawicka	Bark	Delafield	957	90	DG	Mesotrophic	Cold, AQ-1 (RSH)
Norris Foundation Pond	Middle Fox	Vernon	3	8	DG	N/A	FAL
North*	Oconomowoc	Merton	439	78	DG	Mesotrophic	FAL, AQ-2 (RSH)
Oconomowoc	Oconomowoc	Oconomowoc	804	62	DG	Mesotrophic	Cold, 303(d), AQ-2 (RSH)
Okauchee*	Oconomowoc	Oconomowoc	1,187	94	DG	Mesotrophic	Cold, AQ-2 (RSH)
Ottawa	Scuppernong	Ottawa	28	16	SP	Mesotrophic	FAL, AQ-2 (RSH)
Pewaukee	Upper Fox	Delafield	2,493	45	SP	Mesotrophic	FAL, AQ-2 (RSH)
Pine	Oconomowoc	Merton	703	85	SP	Mesotrophic	Cold, 303(d), AQ-2 (RSH)
Pretty*	Bark	Ottawa	64	35	SE	Oligo-mesotrophic	FAL
Rainbow Springs	Mukwonago	Eagle	25	16	SE	N/A	FAL, AQ-3 (RSH)
Reagon	Bark	Ottawa	16	10	SP	N/A	FAL, AQ-3 (RSH)
Roxy Pond	Mukwonago	Mukwonago	17	3	SP	N/A	FAL
Saratoga	Upper Fox	Waukesha	24	6	DG	N/A	FAL
Saylesville Millpond	Middle Fox	Genesee	45	4	DG	N/A	FAL, AQ-3 (RSH)
School Section*	Bark	Ottawa	125	8	DG	Mesotrophic	FAL, AQ-2 (RSH)
Scuppernong Creek Pond	Bark	Ottawa	20	5	DG	N/A	FAL
Silver	Oconomowoc	Summit	222	44	SE	Mesotrophic	FAL, AQ-2 (RSH)
Spahn	Bark	Summit	4	5	SE	N/A	FAL
Spring	Middle Fox	Mukwonago	105	22	SP	Mesotrophic	ORW, AQ-2 (RSH)
Spring (Dousman)	Bark	Ottawa	14	8	SE	N/A	FAL

Lake	Watershed	Township	Surface Area (acres)	Max. Depth (feet)	Lake Type	Trophic State	Classification Code(s)
Sybil	Bark	Summit	2		SE	N/A	FAL
Tamarack	Oconomowoc	Oconomowoc	30	15	SE	N/A	FAL
Tierney	Oconomowoc	Oconomowoc	15	5	DG	N/A	FAL
Upper Genesee	Bark	Summit	37	27	SP	N/A	FAL, AQ-3 (RSH)
Upper Kelly	Root	New Berlin	12	9	SP	Eutrophic	FAL
Upper Nashotah	Bark	Summit	133	53	SP	Mesotrophic	FAL, AQ-2 (RSH)
Upper Nemahbin*	Bark	Summit	283	61	DG	Mesotrophic	FAL, AQ-2 (RSH)
Upper Oconomowoc	Oconomowoc	Oconomowoc	43	11	DG	N/A	FAL
Upper Phantom*	Mukwonago	Mukwonago	110	29	SP	Mesotrophic	FAL, AQ-1 (RSH)
Utica	Bark	Summit	14	25	SP	N/A	FAL, AQ-3
Waterville	Bark	Summit	68	12	DG	Eutrophic	FAL, AQ-3 (RSH)
Widgeon/Bowron	Bark	Summit	25	25	SP	N/A	FAL
Willow Spring*	Middle Fox	Mukwonago	46	13	DG	Mesotrophic	FAL, AQ-3 (RSH)
Wood	Mukwonago	Mukwonago	20	22	SP	N/A	FAL, AQ-3 (RSH)

#### Classification Codes

Cold = Supports a cold water community either naturally occurring or artificially stocked.

FAL = Fish & Aquatic Life. Default classification equivalent to Warm Water Sport Fish Community.

303(d) = Water body appears on the Wisconsin Impaired Waters List

ORW = An Outstanding Resource Water as defined by Chapter NR102 of the WI Administrative Code.

AQ-1 = Identifies Aquatic Areas of statewide or greater significance.

AQ-2 = Identifies Aquatic Areas of countywide or regional significance.

AQ-3 = Identifies Aquatic Areas of local significance.

RSH = Rare Species Habitat. Aquatic areas that support endangered, threatened, or "special concern" species designated by DNR.

\* = Lake has a Lake Management District formed under Chapter 33 Wisconsin Statutes.

#### Lake Type

Drainage lake (DG): Impoundments and natural lakes with the main water source from stream drainage.

Seepage lake (SE): Landlocked. Water level maintained by groundwater table and basin seal. May have intermittent outlet.

Spring lake (SP): Groundwater fed lakes always with an outlet of substantial flow.

Because lake water quality is significantly affected by surrounding land use and cover, urban development and agricultural activity on land that drains into lakes and streams has led to a decline in water quality on many lakes in Waukesha County. Water quality often changes as a result of increasing levels of such nutrients as nitrogen and phosphorus entering a lake. Nitrogen is usually the limiting nutrient for rooted aquatic plants while phosphorus is considered the limiting nutrient for algae growth.

Eutrophication is the condition reached by lakes when the accumulation of nutrients produces increasing amounts of aquatic plants. As the resulting lush aquatic plant growth dies each year, organic deposits fill in the lake. This is a natural process that is generally more prevalent in warm, shallow lakes, such as Big Muskego Lake, than in colder, deep lakes, such as Oconomowoc Lake. However, the process can be greatly accelerated by additional nutrients from inadequate or failing onsite sewage disposal systems, lawn fertilizers, agricultural runoff containing fertilizer and animal wastes, construction site runoff, and street debris.

The trophic status of most major lakes in Waukesha County is also presented in Table II-5. The trophic state serves as an indicator of overall water quality, taking into consideration water clarity, phosphorus



content, algae content, and regional location in Wisconsin. In some cases, the current lake trophic state is a combination of two (i.e. Meso-eutrophic).

A mesotrophic lake shows some signs of eutrophication. The presence of a greater amount of nutrients than in an oligotrophic lake results in lowered clarity and the presence of aquatic plants. Swimming and boating can be enjoyed on this type of lake without limitations.

A eutrophic lake has relatively large amounts of aquatic plants because of higher nutrient levels. The water may be cloudy because of suspended algae cells, dying plants may produce unpleasant smells, and mats of plants may interfere with swimming and boating. These lakes are generally shallow, with mucky bottoms. Eutrophic lakes can be excellent warm-water fishing lakes for such fish as bass and bluegills.

All surface waters in the state of Wisconsin can be classified into one of several biological use objectives classification categories. The classification categories include:

**Cold Water Communities (COLD):** Includes surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species.

**Warm Water Sport Fish Communities (WWSF):** Includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish. This category is the default listing for all streams that have not been formally classified according to the process outlined in meeting the federal Clean Water Act goals. Is also the equivalent of full fish and aquatic waters (FAL) classification.

**Warm Water Forage Fish Communities (WWFF):** Includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.

**Limited Forage Fishery (LFF):** Includes surface waters of limited capacity because of low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of forage fish and aquatic life.

**Limited Aquatic Life (LAL):** Includes surface waters severely limited because of very low or intermittent flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.

## **Outstanding and Exceptional Resource Waters**

Chapter NR 102 of the Wisconsin Administrative Code lists water quality standards for all surface waters in the state of Wisconsin. The two highest classification categories are Outstanding Resource Waters (ORW) and Exceptional Resource Waters (ERW).

An outstanding resource water (ORW) is defined as a lake or stream which has excellent water quality, high recreational and aesthetic value, high quality fishing, and is free from point source or nonpoint source pollution. The only outstanding resource water in Waukesha County is Spring Lake.

An exceptional resource water (ERW) is defined as surface waters which exhibits the same high quality resource values as outstanding resource waters, but which may be impacted by point source pollution or

have the potential for future discharge from a small sewer community. Exceptional resource waters found in Waukesha County include specific portions of the following streams:

Genesee Creek	(Above STH 59)
Mukwonago River	(From Eagle Springs Lake to Upper Phantom Lake)
Oconomowoc River	(From below North Lake to Okauchee Lake)

## Impaired Waters List (303d)

The Department of Natural Resources (DNR) is required every two years to submit a list to the Environmental Protection Agency (EPA) which identifies waters which are not meeting water quality standards, including both water quality criteria for specific substances or the designated biological and recreational uses. This list is known as the “impaired waters list” or simply the “303(d) list” in reference to the particular section of the Clean Water Act.

Several factors can cause waters to become impaired and therefore be identified on the “impaired waters list”. These factors include: 1) Point source dominated; 2) nonpoint source dominated; 3) Point source and nonpoint source combined; 4) Contaminated sediment waters; 5) Atmospheric deposition dominated; 6) Habitat/physical impaired; or 7) Other factors.

DNR most recently prepared a list of impaired waters for submittal to the EPA in 2004. Lakes and streams in Waukesha County which appear on the list are found below along with the impairment factor leading to their listing.

<u>Water Body</u>	<u>Impairment Factor</u>
Bark River	Nonpoint source/point source blend
Barstow Impoundment	Nonpoint source/point source blend
Battle Creek	Nonpoint source dominated
Deer Creek	Nonpoint source dominated
Fox River	Nonpoint source/point source blend
Fox R. (Master Disposal Drainage Channels)	Contaminated sediment
Frame Park Creek	Nonpoint source dominated
Lac La Belle	Contaminated sediment
Little Muskego Lake	Nonpoint source dominated
Mason Creek	Nonpoint source dominated
Oconomowoc Lake	Atmospheric Deposition
Ottawa Lake Beach	Other factors (bacteria)
Pebble Creek Tributaries (Stream C & D)	Nonpoint source dominated
Pine Lake	Contaminated sediment
Poplar Creek	Nonpoint source dominated
Scuppernong River	Physical Habitat
Spring Creek (Sussex Creek)	Nonpoint source dominated
Zion Creek	Nonpoint source dominated

## Land Use

SEWRPC conducts a regular land use inventory of southeast Wisconsin that is intended to serve as a relatively precise record of land use at selected points in time, using aerial photographs augmented by field surveys as appropriate. The first regional land use inventory was prepared by SEWRPC in 1963 and

has been updated every five years following the preparation of new aerial photography, with the most recent inventory prepared using aerial photographs taken in spring of 2000. While aerial photography was completed in the spring 2005, no land use data was yet available for this planning effort.

*Note: As part of the year 2000 land use inventory, the delineation of existing land use was referenced to real property boundary information not available in prior inventories – particularly along road right-of-ways. This change increases the precision of the land use inventory and makes it more useable to public agencies and private interests. As a result of this change, however, year 2000 land use inventory data are not strictly comparable with data from the 1990 and prior inventories. The data remains suitable for denoting general land use trends.*

### Land Use Trends

Table II-7 shows the changes in land use that have occurred in Waukesha County since 1963. The rate of land conversion from rural to urban uses during the 1990s was about 3000 acres per year, or about 4.7 square miles per year – more than any other decade since SEWRPC has been collecting land use data.

**Table II-7**  
**Change in Land Use in Waukesha County: 1963-2000**  
(Acres)

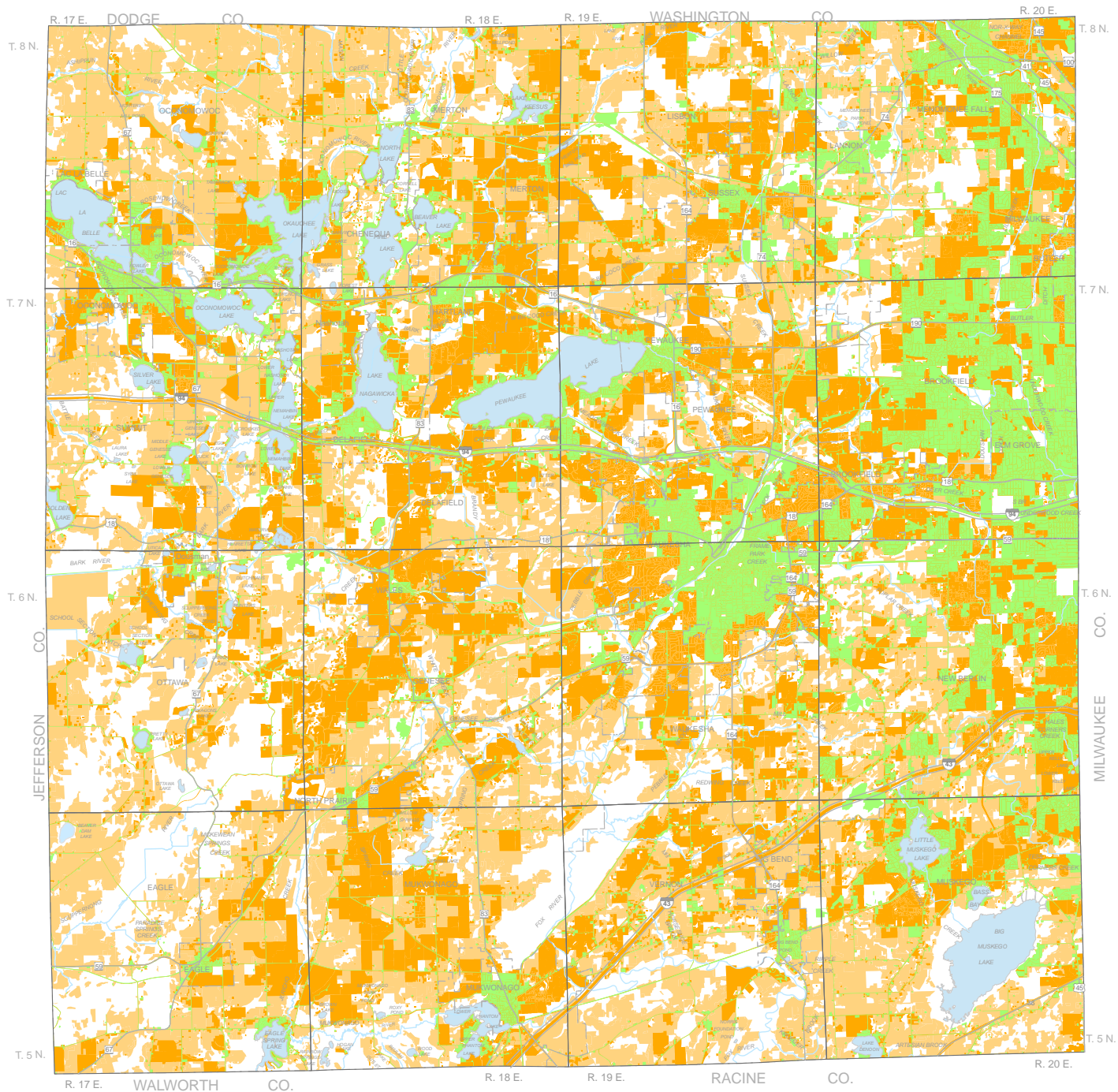
Land Use Category <sup>a</sup>	1963	1970	1980	1990	2000
<b>Urban</b>					
Residential	28,148	35,476	50,745	59,247	75,221
Commercial	1,197	1,831	2,754	3,827	5,351
Industrial	924	1,758	2,747	3,802	5,525
Transportation, Communication, and Utilities	16,079	18,545	21,867	22,805	30,001
Governmental and Institutional	2,550	3,587	4,037	4,215	4,887
Recreational	3,311	4,605	5,756	6,465	8,253
Unused Urban Land	8,509	8,516	8,017	7,025	7,806
Subtotal Urban	60,718	74,318	95,923	107,386	137,044
<b>Nonurban</b>					
Natural Areas					
Surface Water	16,076	16,461	16,753	16,878	16,891
Wetlands	52,588	51,660	51,233	51,978	52,661
Woodlands	31,181	30,818	29,472	29,584	28,931
Subtotal Natural Areas	99,845	98,939	97,458	98,440	98,483
Agricultural	200,241	184,390	161,558	142,428	112,611
Unused Rural and Other Open Lands	10,786	13,943	16,651	23,336	23,397
Subtotal Nonurban	310,872	297,272	275,667	264,204	234,491
<b>Total</b>	<b>371,590</b>	<b>371,590</b>	<b>371,590</b>	<b>371,590</b>	<b>371,535</b>

<sup>a</sup>Off-street parking is included with the associated land use.

Source: SEWRPC.

Map II-11 shows the pattern of rural land conversion to other land uses in the years during the same period. In general, since 1963 the number of acres of land in urban categories has more than doubled, going from 60,718 acres to 137,044 acres in 2000, an increase of more than 225 percent. Much of the increase can be attributed to the amount of land used for residential purposes. In 1963, residential land

# **Map II-11** **Rural to Urban Land Use Conversion in Waukesha County: 1963-Present**

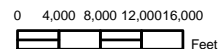
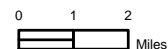


## **Legend**

- 1963 Urban Land Uses
- Land Converted from Agriculture to Urban Uses 1963-2005
- 2005 Agricultural Land Uses

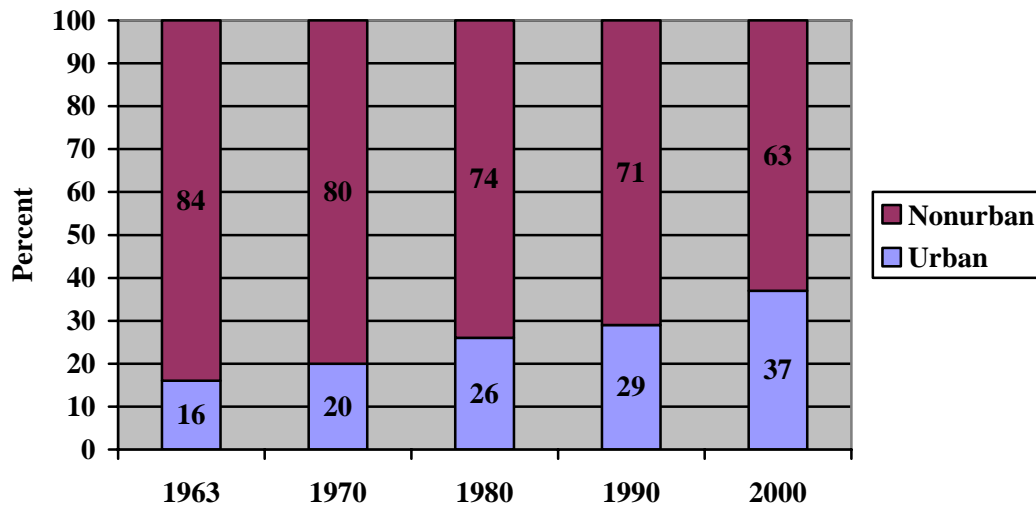
*Note: Agricultural land use data from 2000 SEWRPC inventory. All Subdivisions and condominium plats recorded up to March 2005 have been removed.*

Source: NRCS, SEWRPC & Waukesha County



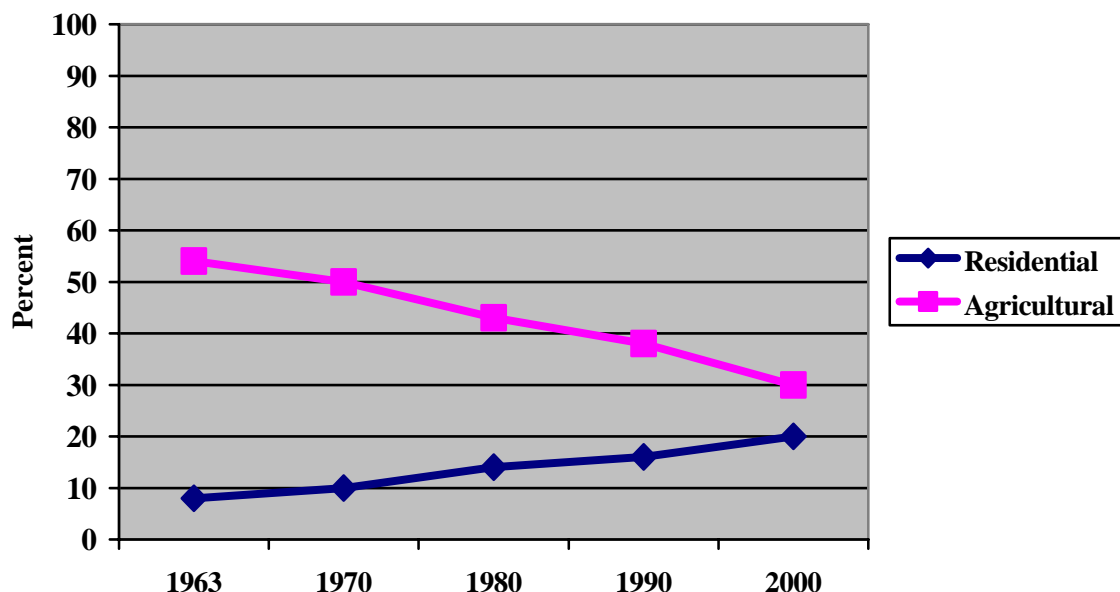
use in Waukesha County totaled 28,148 acres or about 8 percent of the total land use. By 2000 the total number of acres categorized as residential rose to 75,221 or about 20 percent of the total land use. Figure II-7 illustrates the changes in the amount of land in urban and non-urban land uses over the years.

**Figure II-7**  
**Waukesha County Land Use Category by Year**



During the same time period, the amount of land categorized as agricultural experienced a steady decline. In 1963, over 200,000 acres of land were categorized as some type of agricultural use and accounted for 54 percent of the total land use in Waukesha County. By the year 2000 the amount of agricultural land was down to 112,611 acres representing 30 percent of the total land use. Figure II-8 compares the trends in agricultural and residential land uses over the years.

**Figure II-8**  
**Percent of Waukesha County in Agricultural and Residential Land Uses by Year**





## Exotic and Invasive Species

Waukesha County, like many other counties around the state of Wisconsin, has become home to a number of exotic and invasive species of plants and animals. These pests invade lakes, rivers, forests, wetlands and grasslands. They displace native species, disrupt ecosystems, and affect people's livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation and take an economic toll on commercial, agricultural, forestry, and aquacultural resources.

Invasive species found in Waukesha County include: Purple loosestrife, zebra mussels, Eurasian water milfoil, garlic mustard, rusty crayfish, gypsy moth, buckthorn, wild parsnip, and multiflora rose among others. Humans have created conditions where plants and animals can aggressively invade and dominate natural areas and waterways in three ways:

1. Introducing exotic species that lack natural competitors and predators to keep them in check.
2. Disrupting native ecosystems by changing environmental conditions.
3. Spreading invasive species through various methods.

Controlling invasive species can be difficult and expensive. Learning how to prevent the introduction of new invasive species and controlling the spread of those already in Waukesha County will take education. One source of information is the Department of Natural Resources at <http://dnr.wi.gov/invasives/>.

## Summary

While presenting a general overview of the local natural resource features, population growth and land use data, this chapter brings light to the urbanizing pressures faced in Waukesha County. These pressures played a key role in the identification of resources issues and concerns outlined in Chapter III, and the formulation of the activity plan presented in Chapter IV.